THURSDAY, MAY 25, 1899.

RECENT WORKS ON MEDICAL SCIENCE.

1. *The Administrative Control of Tuberculosis.* Being the Harben Lectures delivered in 1898, before the Royal Institute of Public Health, by Sir Richard Thorne Thorne, K.C.B., F.R.S. Pp. 73. (London: Baillière, Tindall, and Cox, 1899.)
2. *Die Bedeutung der Reize für Pathologie und Therapie im Lichte der Neuronlehre.* Von Dr. A. Goldscheider. Pp. 88. (Leipzig: Barth, 1898.)
3. *Twenty-seventh Annual Report of the Local Government Board*, 1897-98. Supplement containing the Report of the Medical Officer for 1897-98. Pp. 331. (London: Her Majesty's Stationery Office, 1898.)
4. *The Natural History of Digestion.* By A. Lockhart Gillespie, M.D., F.R.C.P., F.R.S. (Ed.) Pp. 427. "Contemporary Science Series." (London: Walter Scott, Ltd., 1898.)
5. *Diet and Food considered in Relation to Strength and Power of Endurance, Training and Athletics.* By Alexander Haig, M.A. and M.D. (Oxon.), F.R.C.P. Five Illustrations. Pp. 86. (London: J. and A. Churchill, 1898.)
6. *On Centenarians and the Duration of the Human Race.* By T. E. Young, B.A., F.R.A.S. Pp. 145. (London: Charles and Edwin Layton, 1899.)

1. THE subject-matter of the Harben Lectures, of which the book before us consists, is at the present time of special interest, not only to the medical profession, but to the general public. The country is now thoroughly roused to the importance of the control of tuberculosis, and although the measures considered in Sir R. Thorne Thorne's book are intended primarily for sanitary officials, they should prove of extreme interest and importance to both the general practitioner and the agriculturist.

In the first lecture, the author emphasises the fact that while of recent years the death-rate from pulmonary consumption has very greatly diminished, no corresponding diminution has been observed in the number of deaths due to tubercular lesions of the alimentary tract. The difference ætiologically between these two classes of cases consists mainly in the air being the source of infection in the former, and the food in the latter. The enormous improvement in the arrangement of dwelling-houses and streets with regard to ventilation facilities and drainage suffices to explain the diminution in the phthisis death-rate. According to the author, the absence of improvement with regard to meat and milk supply goes far to account for the death-rate remaining stationary in tubercular disease of the digestive tract. The foods which, for the most part, are the sources of tubercular infection are meat and milk. So far as concerns meat, which is far the less important of the two, the author advises the establishment and exclusive use of public slaughter-houses under administrative control. In these slaughter-houses experts could decide to what extent the flesh of tuberculous beasts was unfit for human food. It is interesting in this connection to note that beasts bred in confinement—*i.e.* with a diminished fresh air supply—are most frequently the subjects of tuberculosis, the disease in wild animals being very rare.

The second lecture is practically devoted to the consideration of milk as a source of tubercular infection. The vast majority of cases of tabes mesenterica (tubercular disease of the intestines) occur at precisely that period of life which corresponds to the maximum milk consumption, viz. early childhood. The deaths under one year of age, returned as due to this cause, amounting to no less than 1·046 per million births. This, according to the author, is in great part due to the prevalence of tuberculosis among milch cows. In England and Wales there are 2,100,000 milch cows, and of these 525,000 are tuberculous. The rejection of al tuberculous cows is impracticable. The administrative control of cow-houses, especially with regard to the amount of cubic space per cow, would, according to the author, greatly lessen this appalling amount of disease. So long as the cow-house remains filthy, the burnished cleanliness of the dairy is unavailing.

The third lecture discusses the *pros* and *cons* of the compulsory notification of phthisis, and is of less interest to the readers of NATURE, although of profound importance to the expert.

The space at our command has only enabled us to touch upon a few of the many interesting points in these lectures. A thorough perusal of them will repay both the general and the special reader.

2. This book is an interesting monograph devoted to the study of the importance of stimuli of various kinds in different disorders of the nervous system. The author's contention is that the effect of the various stimuli, such, for instance, as massage, friction, electric stimulation, &c., which are now used very generally therapeutically, can be explained physiologically, and therefore that these methods must be regarded as part of the legitimate *repértoire* of the physician.

The first chapter is devoted to the physiology of the subject. The author adopts the neuron theory of the nervous system, and goes a step further in that, according to him, each anatomical unit is also a unit physiologically. The unit of nerve activity he terms the neuron wave (Neuronschwelle). Chapter ii. treats of the pathological changes in the neuron waves. A relatively small part of the book is devoted to the explanation of how external stimuli, applied with a therapeutical object, act in certain cases of hyperæsthesia and paralysis. The author thinks that the effect of external stimuli in these conditions is not entirely explained by merely assuming that they form the afferent impulse of a vascular reflex action, but that they also act by disturbing in one or other direction the equilibrium of the excitations (Erregungen) at the time existing in the nervous system. In conclusion, the author considers that the varied phenomena occurring as the result of so-called "suggestion" are all explicable upon this "physiological neuron" hypothesis, and hence are robbed of any mysticism which, from a legitimate medical practice standpoint, seriously restricted the use of this method.

The monograph is to the general physiological reader

somewhat abstruse, and the style involved, but should be of considerable interest and importance to the neurologist.

3. This report contains a mass of interesting fact; the parts of it, however, most likely to be appreciated by the readers of NATURE are the reports contained in Appendices A and B. These are generalised in the report proper as Auxiliary Scientific Investigations. One of the most interesting of these treats of the relation of enteric fever to oysters. The Medical Department was successful in tracking at least twenty-six cases of enteric fever to infection by Brightlingsea oysters. It was also ascertained that, during 1897, infectious matters derived from persons suffering from enteric fever must needs have been discharged in the immediate neighbourhood of certain oyster beds situated in Brightlingsea Creek. The Urban District Council of Brightlingsea are now taking measures which will obviate this pollution of their oyster-beds.

Dr. Klein reports upon bacillus enteritidis sporogenes. This anærobic bacillus occurs under certain conditions in milk, and has a casual relation to infantile diarrhœa.

Dr. Sidney Martin furnishes a report on the viability of the typhoid bacillus in virgin and organically polluted soil. This research, so far as concerns the ability of the typhoid bacillus to thrive in soils containing other bacteria, is at present incomplete.

A short report deals with the relative values of the chemical and bacterioscopic methods of water analysis; from this it appears that, in the case of waters very slightly contaminated with sewerage, chemical methods gave negative results when bacilli could be detected in probably harmful quantity.

Some further interesting observations upon the streptococcus scarlatinæ have been made. It appears that this organism, which is the cause of scarlatina, may haunt the nasal secretion of patients long after desquamation has ceased and recovery has taken place.

4. The "Contemporary Science Series," so well known to the general scientific reader, has, in including this work in its publications, acted very wisely. It is quite impossible in a short notice, like the present, to give any adequate account of the contents of Dr. Gillespie's book. The subject is treated from a thoroughly scientific standpoint, and yet at the same time is made essentially readable even to the general reader. The only two faults to be found with the book are that, firstly, it is too condensed, and secondly, no doubt for the sake of saving space, the complete references to the literature of the subject are not always quoted. Names are from time to time mentioned without the full reference. This fault is somewhat accentuated by the absence of a bibliography, the mere list of authors being actually of little service. The book is thoroughly up to date, and although there is no attempt at making it in any sense a practical handbook, sufficient of the practical is introduced to give point and interest to the descriptive.

In the chapters upon such subjects as foods, alcohols, &c., the author shows a wise discrimination, and does not allow himself to be the mouthpiece of any of the many varieties of faddism which exist. A biological survey of digestion such as the present, containing a description of digestion in plants, as well as in animals, is certain to be of value to the biologist. The chapter on ferments contains an account of the most recent researches in this field. Numerous diagrams and tables, the latter containing a mass of information, add to the value of the work.

5. Dr. Haig's book may be regarded as an appendix to the author's earlier work on "Uric Acid." Many of the views expressed therein, and reiterated here, are not generally accepted either by physiological chemists on the one hand, or by physicians on the other. It is well to make this fact quite clear, as the general reader, into whose hands this book will probably fall, may be apt to think that what the author states as "shown" or "proved" in "Uric Acid" is universally accepted fact. The obstruction of the peripheral capillary circulation by uric acid may be quoted as an instance of this; it is well to emphasise the fact that this is pure imagination. Further, the poisonous properties ascribed to uric acid and the xanthins are by no means established. To the readers of "Uric Acid," such expressions as "a rush of a lot of uric acid into the blood" will be familiar. "A lot" of uric acid has never been demonstrated in the blood under any circumstances, and such an expression must be regarded as highly unscientific and misleading. Upon premises akin to the above and a few experiments, the author recommends what may be termed ultra-vegetarianism; that is, a vegetarian diet from which eggs are excluded, also tea, coffee, alcohol and tobacco. The book is written in a popular style, and it is to be feared that the plausibility of the manner and the attractiveness of the title, by increasing the circulation of the book amongst the public, will tend rather to the perpetuation of faddism than to the advancement of knowledge.

6. This work is a critical and an historical inquiry into a subject which *ipso facto* is of universal interest. The author lays great stress upon the stringent nature of the proof which must be exacted in the case of any claim to having acquired very advanced age. The methods adopted by the Institute of Actuaries may be regarded in this respect as a standard. Some score of examples of centenarians, authenticated beyond all doubt, is given; but the author rejects such instances as William Parr, to whom tradition ascribes the age of 157 years, as unproved. An interesting chapter is devoted to a consideration of the enormous age of the Biblical patriarchs, various hypotheses being advanced in explanation of this. The book concludes with some interesting speculations concerning a possible law of longevity. The author has taken considerable pains to sift well the literature of his subject, and if the whole is not as concise as perhaps it might be, the book contains much that is interesting and instructive. F. W. T.

ROUTH'S DYNAMICS OF A PARTICLE.

A Treatise on the Dynamics of a Particle. By Edward John Routh, Sc.D., LL.D., M.A., F.R.S., &c. Pp. xi + 417. (Cambridge University Press, 1898.)

THIS treatise is intended for the student. It has all the merits as well as the limitations which characterise Dr. Routh's other well-known text-books; and, on the principle of reserving the good wine to the last, we will first consider its limitations, more particularly as an introduction to dynamical science.

It is, however, a doubtful point whether the author intends this treatise to be an introduction; for, although he gives, on p. 3, the usual *elementary* demonstration of the "parallelogram of velocities," he continues:—

"This rule is the same as that given in statics for compounding forces which act at a point. Hence all the rules of Statics, which are derived from the parallelogram of forces, will also apply to velocities. We may therefore infer the triangle of velocities, and all the various rules for resolving and compounding velocities, both by rectangular and oblique resolutions."

The logical conclusion from this remarkable demonstration is that the student is supposed to have studied statics before he has ventured into the shiftier ways of what Dr. Routh calls dynamics. This, of course, is not the Newtonian method; yet the whole fabric is avowedly based on the laws of motion. Fortunately, the student able to enter upon a study of this book is, in all probability, well-grounded in the fundamental principles of dynamics, and will skim through the opening sections too quickly to suffer serious contamination. The very first section will, nevertheless, certainly startle him, for there he learns that

"the science of dynamics is divided into two parts. In one the geometrical circumstances of the motion are considered apart from the physical causes of that motion; in the other the mode in which the motion is produced by the action of forces is investigated. The first is usually called *kinematics*, the second is called sometimes *kinetics* and sometimes *dynamics*."

It passes comprehension that a mathematical writer dealing with the most exact of the exact sciences should have the audacity to adopt a nomenclature which virtually makes the part equal to the whole. The source of the confusion is obvious enough. It is a result of halting between two opinions. The expressive word kinetics is adopted, but statics is ignored as a *branch* of dynamics.

The same clinging to the inconvenient and occasionally illogical nomenclature of a past in which Newton was only half understood is noticeable in other parts of the book, and recalls irresistibly Maxwell's verse:

"The phrases of last century in this
Linger to play tricks—
Vis Viva and *Vis Mortua* and *Vis Acceleratrix*."

Dr. Routh has a strong affection for *Vis Viva*, in spite of the fact that physically it is half this quantity that is the important thing. To be thoroughly consistent he should call twice the potential energy *Vis Mortua!*

A short section is devoted to so-called *accelerating force*, the origin of which is explained in a rather curious way. It is derived from the equation $F = mf$, and is stated to be the quotient F/m. "It is equal to the acceleration, and the word 'force' appears to have been added merely to show from which side of the equation the quantity is derived." The author is apparently ignorant of the fact that this unnecessary phrase is a pedantic translation of Newton's Latin term.

In a neighbouring section, we read that "the theory of work is so much used in statics that only a very brief account is necessary here." This brings us face to face again with a serious blemish of treatment. What logical right has Dr. Routh, in laying the foundations of dynamics, to take statical principles for granted? Does not the parallelogram of forces spring directly from the *definition* of force; and is not that definition ultimately kinetic? Moreover, in a *purely* statical problem forces can do no work; and the introduction of the principle of work into statics is a confession that statics cannot be treated apart from kinetics. In the discussion of certain general dynamical principles (*e.g.* what is too commonly called D'Alembert's), it is usual to appeal to the principles of equilibrium, which have already been established on a sound kinetic basis; but such an appeal is obviously out of place in the treatment of dynamic fundamentals.

Dr. Routh's discussion of Newton's laws of motion is probably the least satisfactory part of the book. There is no clear indication of what is really definition and what is experiential inference in these laws. One term at least is introduced before it is defined, and there is, from time to time, a looseness of language inappropriate to a mathematical treatise. For example, speaking of the momentum of a body, the author says "it may be compounded" by the parallelogram law—compounded, what of, or what with? Within four lines Atwood's "machine" is referred to as a "problem" and as an "experiment." Atwood's machine in the concrete is probably useful enough in *illustrating* to immature minds the meaning of inertia and the law of gravity at the earth's surface; but more it *cannot do*, and any quantitative experiment with it is worthless. As a source of problems to vex the pupil, Atwood's machine in the abstract is of perennial value to the weary examiner.

In § 65 we read:

"The law of gravitation asserts that the forces of attraction of the earth on different bodies at the same place are proportional to the masses of those bodies. This is true whatever be the materials of which the body is made. . . . This is an experimental fact which is independent of the laws of motion. . . . The law of gravitation asserts that g is constant at the same place on the surface of the earth. It is sometimes called the constant of gravitation."

There seems to be a subtle confusion here. The *experimental fact* is that the acceleration due to gravity at any assigned place on the earth's surface is the same for all bodies. The laws of motion *then* enable us to make the first statement quoted above. As for the inconstant g, what possible claim can it have to the high sounding title of the constant of gravitation? Such a nomenclature has sprung from half knowledge; and, if referred to at all (for which, however, there was no necessity), should have been at once condemned with all the authority of a master.

The impression we gain from a perusal of Chapter i. is that Dr. Routh has never seriously considered the logical foundations of the science of dynamics, and has probably never had to deal with students really beginning their studies. Once he gets fairly into the heart of the subject, he rises for the most part distinctly above criticism. Beginning, in the usual way, with examples of rectilinear motion (Chapter ii.), he passes on to motion of projectiles, constrained motion in two dimensions, motion in two dimensions, central forces, motion in three dimensions, and finishes with a chapter on "some special problems." To each chapter is appended a

selection of examples well fitted to test the student's progress. Many of these examples are of the familiar "academic" character, having little reference to natural phenomena; but from time to time, and particularly in the chapter on central forces, we meet with problems of high interest and importance. The effect of planetary perturbations on comets and the disintegration of comets into meteor swarms may be specially mentioned. Then the question of the stability of orbits is discussed at considerable length.

Here and there, however, a few points seem to call for remark. In § 222, Dr. Routh finds it convenient to introduce the term *vector*. It would have greatly facilitated his earlier work had he introduced the term at the very beginning. The conception of a vector quantity in mathematical physics is one which every student should get as soon as possible. It should be impressed upon his mind from the very start as something fundamental and far-reaching, and not merely as a convenient term enabling us "to avoid the continual repetition of the same argument."

The title of § 135 is "Discontinuity of a centre of force"—a most extraordinary collocation of words, and absolutely misleading. There can be no discontinuity of a *centre of force;* the discontinuity (if the term be used at all) is in the incomplete mathematical expression of the solution.

A certain looseness of expression is also apparent in the titles of §§ 186, 187, which are respectively, "Work of a central *force*," and "Work of an elastic *string*."

In Chapter vii. Lagrange's equations are introduced, and a variety of interesting problems in three dimensions discussed, *e.g.* motion of a particle constrained to move on a tortuous curve or on a surface. The case when the surface is an ellipsoid is investigated at considerable length, several of Liouville's results being introduced as examples for solution by the student.

Chapter viii. is devoted to "Some special problems," a title, however, which is a most incomplete description of its contents. The brachistochrone may, in a sense, be called a special *problem*, but, as developed by Tait, Townsend and others, its theory is of a very general character, and abounds in *theorems* of great interest. Following this there is a fairly complete discussion of the motion of a particle relative to the earth when the earth's rotation is taken into account—a problem of no small importance. After a few sections on inversion and conjugate functions, the final "special problem" taken up is Hamilton's theory of action. We doubt if any student, not otherwise instructed, could gather from Dr. Routh's pages the great importance of Hamilton's contributions to general dynamic theory. On p. 394 we read: "These are called *the Hamiltonian Equations of Motion*"; but there is no direct reference whatsoever to Hamilton, and in the index, under Hamilton's name, we find references to "Law of force in a conic" and to "Hodograph," but none to "Action"! In a book, one of whose really valuable features is its system of historic notes, such an omission is inexplicable. In striking contrast there is *full* recognition of the merits of Jacobi, who, as Hamilton himself expressed it in a letter to Andrews, "enriched by his comments" Hamilton's theory. One recommendation the student will do well to follow: let him refer to his "Thomson and Tait." The enunciation of Tait's problem (p. 401) contains a misprint which reduces the statement to an absurdity.

It is a reproach frequently cast by literary men that scientific writers lack style. There is not much scope for a cultivation of style in a mathematical treatise, but surely we have a right to expect good English. In the book before us there occurs with painful frequency the fault of the misrelated participle. On p. 7, an indefinite "it" is found "assuming the principles of the differential calculus"; on p. 145, a (dynamic) couple is represented as "remembering" something; on p. 150, the work done by forces is found capable of "selecting some geometrically possible arrangement," and so on.

By way of general summary we may, in conclusion, remark that, although the first chapter is open to serious criticism, and the book is somewhat marred throughout by a looseness of diction, Dr. Routh's "Treatise on the Dynamics of a Particle" is an important contribution to the literature of the subject. To the working student its value is enhanced by a well-selected stock of examples, many of which appear for the first time in a formal treatise. Some of the problems specially considered are of high interest, and the solutions in many cases are of practical value. In a word, the book fully sustains the reputation of its author as an experienced teacher, now bringing forth from his treasure-house things old and new, and appealing to a wider circle of ardent disciples who will be found wherever the English tongue is heard. C. G. K.

LABORATORY MANUALS OF INORGANIC CHEMISTRY.

Qualitative Chemical Analysis. By Chapman Jones. Pp. 213. (London: Macmillan and Co., Ltd., 1898.)

Practical Inorganic Chemistry for Advanced Students. By Chapman Jones. Pp. 239. (London: Macmillan and Co., Ltd., 1898.)

Advanced Inorganic Chemistry. By G. H. Bailey, D.Sc., Ph.D. Edited by William Briggs, M.A. Pp. 333. (London: W. B. Clive, 1898.)

THE first of the above books appears as one of the well-known series of "Manuals for Students." The tradition of these books is that they are not primarily written for a syllabus, but rather that an author has here an opportunity of developing his own ideas, and producing a book which has individuality. We turn, therefore, with considerable interest to this addition to an already abundant literature to see how far the author has contributed anything new or valuable to analytical teaching. As far as we can gather, the great defect which Mr. Chapman Jones believes to attend the study of analysis is that the student's mind is apt to get filled with a knowledge of isolated reactions, whilst really

"the use of such exercises, as are given in the laboratory, is to the would-be chemist exactly what the practising of exercises and scales is to the young musician. The aim is not merely to perform the exercise, but to do it in such a manner that it shall be practice in a thoroughly sound method of work."

It appears, therefore, that Mr. Chapman Jones sets his mind essentially on producing a correct executant.

Further evidence of this appears in the tables of separations, which are printed on parchmentised paper, and open out on each side of the stitching,

"so that if anything is spilled on to the book as it lies open at any of the tables, the result will not be so disastrous as it otherwise might be,"

and the underlying pages will be protected. This certainly suggests scale practising. Taking the author's purpose as he states it, we have carefully read the book and examined the methods prescribed. We believe certainly that the analytical methods are sound; but we should hesitate to say that, in this respect, this book is superior to a dozen others that could be named. It is written undoubtedly by one who has a mature knowledge of his subject, and the processes described satisfy all reasonable requirements in point of accuracy; but we find hardly anything noteworthy in the mode of presenting the subject or in the details—nothing certainly that will warrant us in saying that this is conspicuously *the* book for a sound method. In other respects, it makes no special claim. The sections of "Comparative Remarks" on the elements or radicals of a group are likely to be useful, but as an exposition of the theory of analysis as well as the practice the book leaves much to be desired.

Mr. Chapman Jones' second book is written to suit the syllabus of the Science and Art Department for practical inorganic chemistry in the advanced stage. The analytical part of it is adapted from the work just noticed. The rest includes the preparation of gases and some volumetric analysis. As all the topics of the syllabus are dealt with, the book will no doubt suit its immediate purpose. The mode of treatment calls for remark in one particular only. The preparations are grouped as follows:—Preparation of gases by the use of cold liquids, ditto by the use of hot liquids, ditto by the heating of dry substances, preparations involving distillation, preparations made in solutions. A protest must be entered against a mode of classification so entirely divorced from educational purpose. Even if there were practical convenience in it, which we do not admit, that would by no means justify a sequence of experiments dictated by considerations of merely having this or that piece of apparatus handy for use.

A book entitled "Advanced Inorganic Chemistry," written for "The Organised Science Series," and containing in the preface a statement that a certain liberality of treatment (of chemical physics) is justified by the importance attached in the syllabus to the subject, is calculated to raise prejudice in the mind of a reader. We make haste to say, therefore, that Dr. Bailey's book contains very little evidence, if any, of having been written to conform to a syllabus, or to provide information in that highly compressed and uninspiring form, which until recent times has seemed to prove most suitable for meeting the requirement of the Science and Art Department. The book begins with a short account of the properties of gases, including a good account of Avogadro's hypothesis, of dissociation, and of the methods of determining the composition of gases. In stating that equal volumes of *all* gases . . . contain the same number of molecules, the author, we think, underlines the wrong word. The whole advance made by Avogadro is surely embodied in the word *molecules:* it was not the introduction of the idea of equal numbers (as beginners are so often taught), nor the mere extension of an existing generalisation. The chapter on the atomic weights of the elements is excellent in most respects, but we regret to see the statement that a measure of the chemical attraction or affinity exerted between two elements is afforded by the heat developed by their union. An unqualified statement of this kind is calculated to instil a fundamentally wrong idea of the relationship between heat and chemical affinity. In the main part of the book dealing with the elements and their compounds, the mode of treatment is broad and luminous, and the information is well selected. Some few deficiencies in detail are to be found; but, on the other hand, there are many little features in which the book is an improvement on others of like scope. The following points are, perhaps, worth noting. Cryohydrates are mostly mixtures of ice and salt, and not definite compounds, as implied on pp. 60 and 67. On p. 103, the production of iodine by the action of sulphuric acid on potassium iodide may be better explained by the reducing action of hydriodic acid on sulphuric acid than by the mere decomposition of the hydriodic acid *per se*. The preparation of silicon from silicon dioxide and of boron from boron trioxide by means of magnesium, and also the preparation of silicon hydride, easily demonstrated in test-tubes, are not mentioned, nor is justice done to the energetic properties of boron. The preparation of potassium chlorate by electrolysis of potassium chloride is not mentioned; and though the electrolytic preparation of sodium is described, the figure which illustrates the process is hardly comprehensible. Three useful appendixes on crystallography, spectrum analysis, and chemical calculations, and a series of chemical problems, conclude the book. Owing to some printing accident, the appendix on spectrum analysis ends prematurely in the middle of a sentence. A. S.

THE MODERN BICYCLE.

La Bicyclette: sa Construction et sa Forme. Par Dr. C. Bourlet. Pp. 228. (Paris: Le Génie Civil; Gauthier-Villars, 1899.)

THIS is a reproduction of a series of articles which appeared in vol. xxxiii. of *Le Génie Civil*, and forms, in some measure, a supplement to the author's "Nouveau Traité des Bicycles et Bicyclettes." With the exception of an appendix on the theory of ball-bearings, the present work is non-mathematical in character, and is addressed to all cyclists who take an intelligent interest in their machines. The first chapter is devoted to an historical summary, then follow chapters on the frame, steering, bearings, gearing, change-speed gears, wheels and tyres, tricycles, accessories, and hygiene of touring.

The work is to be warmly welcomed, as adding to the far too scanty independent literature on the construction of the bicycle. We feel somewhat at a loss, however, as to the standpoint to be taken in reviewing the book. In the historical portion many events which, on this side of the Channel at least, are regarded as of primary importance are not even referred to—*e.g.* Kirkpatrick

Macmillan and Gavin Dalzell's construction of a practical rear-driver, the appearance of the original Dunlop pneumatic tyre with outer cover cemented to the rim, while free-pedals are merely referred to as incidental accompaniments of automatic brakes. Dr. Bourlet's history of the introduction of pneumatic tyres reads like a burlesque :—

"... The first pneumatic tyres were very timid attempts, and at the best only suitable for racing tracks. ... The single tube tyres, Clincher, Boothroyd, and others then became popular, and were a little more trustworthy. ... It was not until Michelin put on the market his detachable tyre that pneumatic tyres entered the domain of practical cycling mechanics. ... Six months later the Dunlop Company exhibited a detachable tyre. ..."

Again, in the purely descriptive portions of the book many important developments of the last three or four years are entirely unnoticed ; to wit, Lloyd's cross-roller gear, the Fleuss and Trench tubeless tyres, jointless hollow rims, short-pitch roller chains, the Bowden brake transmitting mechanism ; in fact, the book is at the date of its publication several years behind the times, as far as the bicycle in England is concerned.

The discussion of the various points of construction are very interesting and instructive ; but the conclusions drawn by the author are in many cases diametrically opposed to opinions widely held on this side of the Channel. The author has proved that, for ease of steering, the frame of a good bicycle should be as short as possible ; the frame with extended wheel-base "était donc détestable ; il manquait d'ailleurs de rigidité." The frame of the Pedersen bicycle, weighing less than 20 lbs. complete, receives most praise ; but the author would improve it by substituting pin-joints for the rigid lugs. Mr. Mushing's analysis in the Centaur Company's catalogue of the weight of a bicycle equipped as a heavy roadster and as a road racer (total weights 36 lbs. and 25 lbs. respectively, weight of frame and front forks in each case 7 lbs. 15 oz.) might modify the author's opinion on this point.

In chains, a retrograde movement was effected when, in 1895, English makers returned to the detestable block chains, "un peu modifiées, il est vrai, mais toujours aussi mauvaises." Now, whatever be the merits of the 1899 roller chains, the old inch-pitch roller chains were much worse than the block chains which superseded them. Has the author compared, say, a Hans Renold block chain with the roller chains made prior to 1895? The type of roller chain held up for admiration is that with each sleeve split at the middle, a half-sleeve being made as a solid internal projection from each inner side-plate. This construction is thoroughly bad, and no chain made in this way is durable, as some chain-makers have found to their cost.

A great number of two-speed gears are described, none of which have been sold to any extent in England, while the few two-speed gears known here are not referred to. This chapter is therefore of interest mainly to the mechanician and the designer.

As a practical guide to the cyclist in choosing a new machine, the book will be of most service in France, but of little or no value here. A. S.

OUR BOOK SHELF.

The Spirit of Organic Chemistry. By Arthur Lachman, B.S., Ph.D. With an Introduction by Paul C. Freer, M.D., Ph.D. Pp. ix + 229. (New York : The Macmillan Company. London : Macmillan and Co., Ltd., 1899.)

THE title of the book, if it conveys a definite idea, scarcely explains the contents. The preface, however, sets forth the various objects which the book is intended to accomplish. Its main purpose, we are told, is to supplement the text-book and to introduce the student to the current literature of the subject, from which it is to be inferred that he will be equipped with a sufficient knowledge of present problems to follow contemporary research.

The volume consists in reality of a series of essays on subjects which have at one time or another engaged the attention of chemists. It is divided into chapters, the heading of each furnishing the text for a discourse on some prominent theory or classical investigation. "The constitution of acetoacetic ether" leads up to an account of *tautomerism*. The constitution of the sugars, of maleic and fumaric acids, of the oximes and of the diazobenzene compounds, involve a series of dissertations on stereochemical problems ; whilst the chapters on uric acid and the constitution of rosaniline record the development of certain branches of synthetic chemistry. An essay on the constitution of benzene, and a brief history of "Perkin's reaction," complete the series. The subjects are not by any means exhaustively treated ; but they are presented in an easily readable form, and controversial matters are handled in a judicial spirit.

Whether these few essays will enable the student to follow current literature is another question. A great amount of organic research is now busy with the constitution of the terpenes, the camphors, the alkaloids, the artificial and natural colouring matters, and many other subjects of which no word is said. Moreover, several of the subjects discussed have passed into history. Still, there will doubtless be many to whom the volume should prove interesting and profitable reading.

The introductory chapter does not add substantially to the value of the book. Its rather high-sounding phrases convey little real information, and the historical references are too brief to be intelligible to any one ignorant of the history of the science. J. B. C.

Elementary Physics and Chemistry. First Stage. By Prof. R. A. Gregory and A. T. Simmons, B.Sc. Pp. viii + 150. (London : Macmillan and Co., 1899.)

THE importance of experimental science teaching in elementary schools is being more and more recognised by the Education Department every year. This tendency is seen in the course of elementary physics and chemistry for the upper standards, which was introduced into the Elementary Education Code for 1898. To meet the want thus created is the purpose of the present book, covering the first of the three parts into which the syllabus is divided. The plan of the book is admirable, and though the division of each lesson into "what to do," "reading lesson," and things "to be remembered," involves a certain amount of repetition, there will be compensation to young students in the resulting clearness. Matters are so arranged that the lessons are suitable for classes in which each pupil can perform the experiments for himself, or for those in which they can be made by the teacher alone. In their anxiety to secure a logical sequence of thoughts, the authors have included a few experiments, the results of which we think might have been taken for granted ; but, apart from this, the book seems well adapted for beginners in science. The clear and simple language, combined with a large number of excellent illustrations, can surely leave no doubt in the mind of the dullest pupil as to the ideas which are intended to be conveyed.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Mangroves Growing in Japan.

HAVING resided for some years in the eastern part of Japan, and having travelled from time to time in various parts of the island of Kiusiu, and from thence to the Farther Isles within the southern boundary of the Luchuan Archipelago, I have noticed that the tropical and sub-tropical types in the Japanese flora are much more marked than has hitherto been supposed. As an instance of this, a selection from the types of mangroves will probably be of more interest, not only to botanists, but also to all lovers of nature, than a list of plant-names.

FIG. 1.—Thickets of *Kandelia Rheedii*, Wight et Arn., growing together with *Pinus densiflora*, Sieb. et Zucc., found on the sides of a stream at Kiiré in Satsuma, Japan. (Reproduced from an original photograph taken by Prof. K. Mitsukuri.)

The northernmost limit of the mangroves in Japan is found in the coast of Kiiré at Satsuma in Kiusiu, where the only species represented is *Kandelia Rheedii*, Wight et Arn. The occurrence of the mangrove in that place is of high interest to geographical botany, inasmuch as that familar representative of tropical vegetation is found there actually intermingled with that of the temperate flora, *Pinus densiflora*, Sieb. et Zucc. This curious and interesting combination is shown in the accompanying illustrations, which were reproduced from the original photographs by Prof. K. Mitsukuri of the Imperial University of Tokyo. Fig. 1 is a fair representation of an outlet of the stream along the coast in the Bay of Kagoshima. Both sides of the stream are studded here and there with the low thickets of *Kandelia Rheedii*, Wight et Arn., among which the evergreen *Pinus densiflora*, Sieb. et Zucc., stands with its outstretching branches. A little further along the coast discloses a finer view (Fig. 2) of the mangrove, forming dense thickets in front; on the background upon the ridge of the hill, a range of *Pinus densiflora*, Sieb. et Zucc., is seen in the distance.

Coming to the island of Amami-Ōshima, the mangroves are common. Here, besides *Kandelia Rheedii*, Wight et Arn., another interesting species, *Bruguiera gymnorhiza*, Lam., makes its appearance. I may here state that Döderlein was, I believe, the first European botanist who collected these species in Japan (vide *Botanisches Centralblatt*, viii., 1881, p. 30, and Engler's *Botanische Jahrbücher*, vi., 1885, p. 63).[1] If we proceed again and come to the island of Uchinā or the Lūchū Proper, and from thence to the Yayeyama Archipelago, which is situated close to Formosa, we find in these islands an additional species, *Rhizophora mucronata*, L. It is in the Yayeyama Archipelago that the mangroves exhibit their full development. In the island of Irumuti, the largest among the Yayeyama Archipelago, they often exceed ten feet in height, and exhibit the characteristic feature of the "mangrove forests" (*Mangroven-Wälder*) of the tropical coasts, so admirably described by A. F. W. Schimper ("Die indo-malayische Strandflora," Jena, 1891) and by Karsten ("Ueber die Mangrovenvegetation in malayischen Archipel," Cassel, 1891). Besides, *Avicennia officinalis*, L., and *Sonneratia alba*, L., the well-known associates of the mangroves, are now recorded to grow in the Yayeyama Archipelago.

I observed, in the last-mentioned archipelago, that the fruit of the mangroves when ripe, produces, as is well known, hypocotyl, which soon develops and elongates, and that, in *Rhizophora mucronata*, Lam., it usually becomes 20–40 cent. or more, when the fruit drops on the ground and becomes transfixed. I may also confirm the statement made by Warming (in Engler's *Botanische Jahrbücher*, iv., 1883, p. 519) against the well-known notion that in mangroves the roots produced from the ripe fruits *on* the trees hang down in the air, in the manner of banyan trees, and develop until they reach water, penetrate the mud, and become in time independent trees.

Thus we observe that the three species of the mangroves are at present known to grow in Japan. In conclusion, I may here remark that the thickets of *Kandelia Rheedii*, Wight et Arn., found at the mouth of the river Yawata as well as at the coast between Nukumi and Mayenohama in Satsuma in the Bay of Kagoshima, and also those at Kashiwabara in Ōsumi, all of which being situated between 31° 18′–31° 23′ N. lat., are, I think, the northernmost limit hitherto known of Rhizophoraceæ.

Tokyo, April 13. TOKUTARO ITO.

The Development of the Tuatara.

IN the last number of the "Anatomischer Anzeiger" received in New Zealand, there is a paper by Dr. Schauinsland on the development of the Tuatara, confirming the results obtained by Dr. Dendy. A preliminary account of these results has already been published in the *Proceedings* of the Royal Society (vol. lxiii. p. 440), to which Schauinsland makes no reference, although they have been reported in NATURE, while the more detailed memoir was accepted by Prof. Lankester for publication in

FIG. 2.—View of the coast near Kiiré with the thicket of *Kandelia Rheedii*, Wight et. Arn., in front.

[1] The more technical account concerning the determinations of these specimens collected by Döderlein will be published elsewhere.

the *Quarterly Journal of Microscopical Science*, and is, no doubt, by this time in the hands of zoologists.

But it is mere justice to my friend, Prof. Dendy, to place before our European colleagues the following facts in regard to Dr. Schauinsland's reference to the inactivity and lack of enthusiasm exhibited by Colonial zoologists in the matter of this most interesting member of our local fauna.

The Tuatara is quite properly "protected" by the Government of New Zealand; permission to obtain material for the investigation of its life-history was granted to Dr. Dendy, and the lighthouse-keeper on Stephen's Island, a Government servant, was permitted to collect the eggs and embryos for him. But subsequently, and without any communication with Dr. Dendy, and before he had obtained more than a few (if any) eggs, the Government also gave permission to Dr. Schauinsland to collect eggs, and moreover instructed their servant on Stephen's Island to give him every assistance.

In this instance, then, Dr. Schauinsland's charge of lack of enthusiasm is not only baseless. but wanton.

The following fact is not without bearing in this connection. A certain foreign zoologist was recently on a visit to New Zealand for the purpose of collecting the rarer and more characteristic animals, amongst others the Bulimoid pulmonate, *Placostylus bovinus*. Having obtained all the individuals living, as well as shells only, on which he could lay his hands, he proceeded to crush all the young ones he could see, and was heard to remark that if any future zoologist or conchologist wished for a specimen he would have to go to a certain town in Europe (and not to New Zealand).

Dunedin, N.Z., April 13. WM. BLAXLAND BENHAM.

THE GIPSY MOTH, AND ITS INTRODUCTION INTO AMERICA.

MANY persons, whether entomologists or not, must have noticed a rather slender, dark-coloured moth with feathery antennæ flying among bushes on the continent; and a much larger, stout-bodied, whitish-grey moth, sitting on hedges, or on the trunks of trees. Dissimilar as these insects may appear, they are nevertheless the male and female of the Gipsy Moth (*Porthetria dispar*), the male of which flies about in the day-time like that of the Vapourer Moth (*Notolophus antiquus*), a small tawny-brown moth with a white spot on the fore-wings, which has an apterous female, and the caterpillar of which feeds on a great variety of trees and shrubs (Fig. 1).

The two moths are not distantly related, both belonging to the family *Liparidae*, but while the Vapourer Moth is so common with us that it is often seen flying even in the streets of London, wherever there are any trees near, the Gipsy Moth is now so rare here as to be thought to be extinct in England, though it is abundant, and often destructive, on the continent. The entomologists of the last century speak of it as very rare in England, and as having been introduced into the orchards of Chiswick, where, however, it failed to establish itself. Subsequently, Stephens wrote that it was rare in the neighbourhood of London, though it had been taken occasionally at Coombe Wood, but that it was abundant in the fens of Huntingdonshire. It is very singular that several insects of general distribution on the continent, among which we may specially mention *Papilio machaon*, *Lycaena dispar*, and *Porthetria dispar*, should have ound their last stronghold in England, like the Britons and the Saxons, in the fens, though the Gipsy Moth was formerly common in fens which are still undrained, as well as in some which no longer exist. It is also remarkable that the English fen-specimens of both the butterfly and moth named *dispar* were much larger and finer on an average than the continental representatives of the same species; and that both should have become practically extinct in England since the drainage of the fens.

In 1857, Stainton wrote of the Gipsy Moth: "This species is apparently less common here than formerly," and mentioned Halton in Buckinghamshire, and Stowmarket in Suffolk, as localities. After this time, the moth became rapidly scarcer, and I am not aware that any authentic British specimens have been taken of late years, though a degenerate breed of British origin was preserved among entomologists for a long time, and may be still.

Far different has been the history of the Gipsy Moth in America, where it is not indigenous, though the insect extends across the northern part of Asia-Europe from England to Japan, and is abundant, if not destructive, in most parts of its range.

Thirty years ago, a French entomologist, named Leopold Trouvelot, was living at Medford, in Massachusetts. He was engaged in carrying on a series of experiments on rearing moths, which he thought might possibly be made useful as silk producers. Among other species, he imported the Gipsy Moth, and, by some accident, some of the insects escaped from his custody into his own or the neighbours' gardens. The most

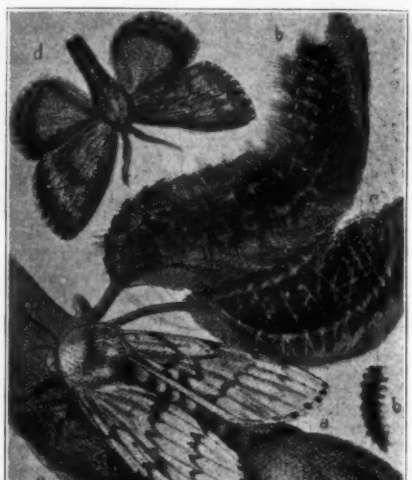

FIG. 1.—Gipsy Moth: *a*, egg mass; *b*, caterpillars; *c*, chrysalis; *d*, male moth; *e*, female moth. (Reproduced from "Insects: Friends and Foes." By Dr. W. Egmont Kirby. Partridge and Co.)

probable story is that some eggs were blown out of the window, and that M. Trouvelot was much concerned at not being able to find them; for the female is a very sluggish insect, which is seldom or never seen on the wing.

Had prompt measures been taken, the insect might possibly have been exterminated; but it does not seem to have attracted any attention till about 1880, when the people then living in or near M. Trouvelot's former residence began to be troubled with swarms of caterpillars, though what they were, and whence they came, was then unknown. For several years the neighbouring houses suffered severely, apple- and pear-trees and shade-trees being stripped of their leaves and killed, and the caterpillars creeping all over and into the houses. Nevertheless, they spread very slowly along the street, and into the surrounding woods till 1889, when the insects multiplied so much that the caterpillars stripped all the trees in the immediate neighbourhood of M. Trouvelot's old house, and then marched forth in

armies sufficient to blacken the streets, in search of fresh provender. A terrible account of the ravages of the caterpillars is given by those who witnessed them, and the town became thoroughly alarmed. Specimens of the insect were sent to the Agricultural Experiment Station at Amherst, Massachusetts, where it was identified by Mrs. C. H. Fernald and her son, in the absence of Prof. Fernald, who happened to be travelling in Europe at the time. On his return, he at once visited Medford, and recommended spraying all infested trees with Paris Green, an arsenical preparation which had previously been employed with great success in checking the ravages of the Colorado Potato Beetle. A pamphlet containing descriptions and figures of the insect in all its stages, with hints for its destruction, was printed and largely circulated; and the veteran agricultural entomologist, Prof. C. V. Riley, gave it as his opinion that if Prof. Fernald's recommendations were carried out at all strictly, there was little fear of the insect spreading, and that it might be entirely exterminated with the expenditure of a little time and money.

FIG. 2.—Destroying the eggs of the Gipsy Moth in the Middlesex Fells Reservation.

In March 1890 a Commission was appointed with full authority to take any necessary measures for the destruction of the pest, and a sum of 25,000 dollars was placed at the disposal of the Commissioners, any person convicted of knowingly spreading the insect, or interfering with the work of the Commissioners, being rendered liable to heavy fines or imprisonment.

As soon as the Commissioners had made a preliminary investigation, it was discovered that the infested area was far larger than had been supposed, and that the grant of 25,000 dollars was wholly insufficient. Large quantities of eggs were destroyed, brushwood cleared, and trees sprayed with Paris Green, while the principal roads leading from the infested district were guarded by policemen, whose duty was to see that caterpillars should not be carried about by passing vehicles.

In 1891, a fresh Commission was appointed, under the auspices of several of the most eminent American entomologists, and Prof. C. H. Fernald was subsequently appointed entomological adviser to the Committee. During the first six weeks of the year, three-quarters of a million egg-clusters were destroyed, estimated to contain from three to five hundred millions of eggs.[1] During the fine season, the trees were sprayed, and in autumn egg-gathering again commenced. Seventy-five thousand dollars were spent this year, and, though the insect was not exterminated, its numbers were seriously reduced. By this time, no less than thirty townships were found to be infested with the insect.

Year by year the campaign against the moth has been continued on similar lines, though impeded by frequent delays in the appropriation grants, as well as by the insufficiency of the amounts, and in 1896 Mr. E. H. Forbush (the field director in the work of destroying the Gipsy Moth) and Prof. Fernald published a volume of 600 pages on the insect and its history, from which much of the information in the present paper is derived. We have also just received the "Report of the State Board of Agriculture on the Work of Extermination of the Gypsy Moth," presented to the Senate and House of Representatives of the Commonwealth of Massachusetts on January 1, 1898, and containing an account of the work of the Committee during 1897. From this we learn that the Committee applied for a grant of 200,000 dollars for the work of that year, and the Legislature promptly granted them three-quarters of the amount. Much work was done (Figs. 2 and 3), and infested districts were cleared as far as the amount would permit, but the Committee's recommendation was for "an appropriation of not less than 200,000 dollars a year for a term of not less than five years, and then an appropriation of not less than 100,000 dollars a year for a term of not less than five years. After this, an appropriation of perhaps 15,000 dollars a year for a period of five years will be required." On this, Prof. Fernald remarks: "The first five years, with the full appropriation of 200,000 dollars a year, will reduce the territory to such an extent that

FIG. 3.—Destroying masses of Gipsy Moth eggs on rocks and ledges.

[1] These eggs are laid in clusters and covered with down from the abdomen of the female.

with 100,000 dollars a year for the next five years the insect will be practically exterminated, and the remaining five years will be spent in a careful watch of the entire territory, lest a few insects might have been overlooked in isolated localities. Unless a sufficient amount is appropriated to make a very substantial gain each year, it would be better to abandon the work entirely."

It is perhaps not surprising that, after having already spent half a million of dollars in what many persons, rightly or wrongly, considered the hopeless task of exterminating a single insect, the Committee's application for a continuous grant of 200,000 dollars annually should have met with much opposition. A proposal was made to reduce the amount of the grant for 1898 to 75,000 dollars; but it was successfully resisted, and ultimately the full amount of 200,000 dollars asked for was granted for the year.

Another European moth-pest has lately been introduced into America—the Wood Leopard Moth (*Zeuzera pyrina*), which is at present rapidly destroying the shade-trees of New York. But this insect is still more difficult to deal with than the Gipsy Moth, for its naked yellow, black-spotted caterpillar feeds inside the wood of the trees, like that of the Goat Moth, to which it is allied; whereas the black, red-spotted tufted caterpillar of the Gipsy Moth feeds exposed on the leaves of its food-plants.

Different countries exchange their injurious animals and plants from time to time, but no one can tell beforehand which species are likely to establish themselves and to become injurious. We have seen that the Gipsy Moth had ample opportunities of becoming as injurious in England as in America; but, nevertheless, it has died out.

On the other hand, the Woolly Aphis (*Schizoneura lanigera*), which is one of the worst pests of our apple-trees, is said to have come from America, and is often called the American Blight. The vagaries of plants are equally uncertain. Our common water-cress, a harmless plant enough, one would think, has developed a giant form in New Zealand, which is blocking up the water-courses. In the middle of the present century, an American water-plant (*Anacharis alsinastrum*) was introduced into England by some accident, like the Gipsy Moth into America, when it was called the new water-weed, and caused great trouble for a time by choking up rivers and ponds. Fortunately, however, after a few years the plant seems to lose its vitality, and ceases to become a pest, owing, as is supposed, to the female plant only having been introduced into England, and it therefore propagates by buds alone.

Time will show whether the Gipsy Moth will continue its devastations in America, or whether it will either be exterminated by the energetic measures taken for its destruction, or by the conditions of American life proving ultimately unfavourable to it, notwithstanding its first rapid increase. It is evident that, although we cannot avoid the accidental introduction of injurious plants and animals from abroad, some care should be taken in introducing any which might become injurious into another country. M. Trouvelot's experiments were intended to benefit the silk industry in the United States; but they have resulted in letting loose a pest which hundreds of workers are now striving, at enormous annual expense, to eradicate if they can. Let us hope that their efforts may be crowned with success, for otherwise the whole of temperate North America may suffer more or less severely, as the infested districts of Massachusetts are now suffering.

W. F. KIRBY.

THE AUSTRALASIAN ASSOCIATION.[1]

AN Association for the Advancement of Science which can produce, as the record of one year's proceedings, such a volume as the one before us, is at once an indication that a widely-spread interest in science and a vigorous scientific activity already exist, and a promise of future progress. It is a volume on the production of which the Australasian Colonies may be sincerely congratulated.

The Australasian Association for the Advancement of Science held its first session at Sydney in 1888; it next met in Melbourne in 1890; then in Christchurch (New Zealand) in 1891, in Hobart (Tasmania) in 1892, in Adelaide in 1893, in Brisbane in 1895, and in Sydney again in 1898. We do not know whether the fact that only one meeting was held in the five years from 1893 to 1898 was connected with the commercial difficulties through which Australia has recently passed; if so, we trust that the resumption of meetings last year may be taken as a sign of returning prosperity.

The constitution of the Association and the order of proceedings at the general meetings are evidently closely modelled on those of the British Association. The public proceedings begin with an evening address delivered by the President for the year; on the following days, meetings of the several Sections are held, relieved by evening lectures, including one to "working men," conversazioni and concerts, garden parties (with "the number of invitations limited"), Saturday afternoon excursions, and, to wind up the whole entertainment, excursions going further afield. One who is accustomed to the doings at the annual gatherings of the British Association would find himself familiar with the whole programme of its Colonial counterpart. Perhaps he might find his way into a Section whose name and subject he had not been used to in the old country, but he would find most of them just what he was accustomed to, as the following list of Sections will show, namely:—Section A—Astronomy, Mathematics, and Physics; Section B—Chemistry; Section C—Geology and Mineralogy; Section D—Biology, with the sub-departments Botany and Zoology; Section E—Geography; Section F—Ethnology and Anthropology; Section G—Economic Science and Agriculture; Section H—Engineering and Architecture; Section I—Sanitary Science and Hygiene; Section J—Mental Science and Education.

To review with any completeness a volume of over eleven hundred pages, dealing with the almost unlimited range of subjects covered by the ten Sections here enumerated, is obviously impossible. All that we can attempt is to indicate some of what appear to us to be among its more noteworthy contents.

There can be little doubt that the most serious contribution to pure science contained in it is the "Report on our Knowledge of the Thermodynamics of the Voltaic Cell," by Mr. E. F. J. Love. This is a really admirable account of the results that have been obtained, chiefly by Lord Kelvin, Willard Gibbs, and von Helmholtz, by the application of thermodynamic considerations to voltaic phenomena. These results are deduced simply and concisely, and are discussed throughout in relation to the experimental tests to which they have been subjected by various observers. It would, we think, be welcome to many physicists if this paper were reprinted in some more generally accessible publication than the bulky volume before us.

In his presidential address to Section A, Mr. Baracchi, Government Astronomer at Melbourne, gives a very interesting account of the great International Photographic Survey of the Heavens, and especially of the share in this

[1] "Report of the Seventh Meeting of the Australasian Association for the Advancement of Science," held at Sydney, 1898. Pp. lii + 1161.

work undertaken by the Observatories of Sydney and Melbourne. Another part of his address is devoted to urging the importance of a systematic magnetic survey of the Australasian Colonies, and establishing a permanent magnetic observatory in New Zealand. Among other communications to this Section, we may mention an elaborate account of the Trigonometrical Survey of New South Wales, by Mr. T. F. Furber. This work is apparently being carried out with great judgment and skill. The author gives a comparative table, showing the mean errors of the angles in a large number of surveys carried out in Europe, the United States, and elsewhere, which seems to justify him in saying that "The above figures speak for themselves in showing that our work is probably equal to that done in any part of the world." A tide-predicting machine, described by Captain A. Inglis, seems to be recommended by simplicity of construction; the periodic components are represented by templates cut to accurate sine-curves, with appropriate differences of wave-length, which are all fed through the machine at the same speed.

Naturally Australasian fauna and flora, geography and geology, supply material for a large number of descriptive papers. Among these, "A short Dichotomous Key to the hitherto known Species of Eucalyptus," may be remarked. The author, Mr. J. G. Luchmann, identifies no less than 140 species of this, the most important Australian genus of timber-trees. In connection with this paper, we may mention a timely and very earnest protest by Mr. W. S. Campbell against the wantonly improvident destruction of forest trees which is, unfortunately, so common in Australia, as well as in the United States and Canada.

Some of the fundamental questions of social economy, including the production and distribution of wealth, are ably dealt with by Mr. R. M. Johnston, Government Statist of Tasmania, in a presidential address to the Section of Economic Science and Agriculture. Some of Mr. Johnston's conclusions by no means coincide with what are at present fashionable in certain circles in this country, as will be evident from the following quotation: "It is the country which relatively places the smallest number of hands on the land for the production of food and raw products which has also attained the highest stage of progress. . . . I deny, therefore, most emphatically that whatever distress in the United Kingdom still exists would be lessened by any scheme which would place more hands on the land than its economic conditions demand for the production of food and raw products."

The social conditions of the Colonies apparently encourage a relatively great development of governmental participation in industrial operations. After giving some interesting records of his experience as Engineer-in-Chief of Railways and Public Works in South Australia, Mr. A. B. Moncrieff strongly urges the adoption, by the different Colonies, of a uniform system of preparing estimates and keeping records of public engineering work; for, as he rightly points out, in the absence of such a system it is not possible to institute fair and useful comparisons between the works carried out by the engineers of the different Colonies, such as are needed to promote a healthy rivalry among them. The work undertaken for supplying water for agricultural purposes over large areas of dry country seems likely to have very important and beneficial results. Mr. Moncrieff gives some interesting particulars of these operations, and mentions one boring that has been carried to a depth of 3000 feet, which yields 800,000 gallons per day of excellent water at a temperature of 176° F.

A large proportion of the most interesting papers in the volume, including most of those we have mentioned, are due to men who are at the head of various official departments. If the authors of these papers may be taken as fairly representative of their colleagues, we think there is ground for congratulating the Australasian Colonies on the intellectual quality of their chief officials. It appears clear that these men do not rely for departmental efficiency on a blind following of routine, but on an intelligent recognition of the conditions under which they are placed, and of the true nature of the facts with which they have to deal.

Taking the volume as a whole, it gives evidence of solid progress achieved and assurance of future advance.

SIR FREDERICK McCOY, K.C.M.G., F.R.S., &c.

IN the death of Sir Frederick McCoy, geological science loses one of its most devoted and enthusiastic disciples, one who in early life was associated with Sedgwick in the preparation of that classic work, the "Synopsis of the Classification of the British Palæozoic Rocks; with a systematic description of the British Palæozoic Fossils in the Geological Museum of the University of Cambridge," a quarto volume published in 1855.

Sir Frederick McCoy was the son of Dr. Simon McCoy of Dublin, in which city he was born in 1823. He was educated at the Universities of Dublin and Cambridge, and intended at first to devote himself to the medical profession, but natural history, and the study especially of fossil organic remains, absorbed his chief attention. When but eighteen years of age he had prepared and published a Catalogue of Organic Remains exhibited in the Rotundo, Dublin. Later on, he assisted Sir Richard Griffith in his researches on the fossils of the Carboniferous Limestone of Ireland, and afterwards they prepared a joint "Synopsis of the Silurian Fossils of Ireland," which was issued in 1846. In the same year, McCoy went to Cambridge to help Sedgwick, and we learn (from the "Life and Letters" of that eminent professor) that the new assistant devoted himself for at least four years "uninterruptedly and with unflinching zeal" to the determination and arrangement of "the whole series of British and Foreign Fossils" in the Museum. In 1850, he was appointed Professor of Geology in the Queen's College, Belfast. Meanwhile, he continued to labour at the great work previously mentioned, and which associates the names of Sedgwick and McCoy in the minds of all students of the Cambrian and Silurian rocks. This work was barely finished when McCoy, in 1854, accepted the newly-founded Professorship of Natural Science in the University of Melbourne.

Apart from the larger works to which he had contributed while in this country, McCoy had published numerous papers dealing with fossil Fishes, Crustacea, Echinoderms, Corals, and Foraminifera. He was indeed well prepared for the arduous and successful labours which he now undertook in a new home. Becoming associated with the Geological Survey of Victoria, he established the "Prodromus of the Palæontology of Victoria; or Figures and Descriptions of the Victorian Organic Remains," issued in decades, and he contributed many palæontological reports for the Survey. He also founded the Melbourne National Museum. His latest contribution to science, "Note on a New Australian *Pterygotus*," was printed in the *Geological Magazine* during the present month.

In 1879, he received the Murchison Medal, which was awarded to him by the Geological Society of London, of which society he became a Fellow in 1852. In 1880, he was elected a Fellow of the Royal Society, and he was one of the first to receive the honorary degree of D.Sc. from the University of Cambridge. In 1886, he was made a C.M.G., and in 1891 he was worthily promoted to be K.C.M.G. It is astonishing to note that, while for fifty-eight years he contributed to palæontological literature, his age at his death in May 1899 should be no more than seventy-six.

H. B. W.

THE EDINBURGH CHAIR OF PHYSIOLOGY.

THE following is the closed list of candidates for the chair of Physiology in the University of Edinburgh, rendered vacant by the death of Prof. Rutherford: Dr. Wace Carlier and Dr. Noel Paton, Edinburgh; Prof. Reid, Dundee; Prof. Schäfer, London; Prof. G. N. Stewart, Cleveland, Ohio; Prof. Stirling, Manchester; Prof. Anderson Stuart, Sydney.

The Edinburgh chair of Physiology, though founded in 1742, has almost invariably been occupied by physicians—amongst others Cullen, Gregory, Alison, and Rutherford's immediate predecessor, Hughes Bennett. The one striking exception in addition to Rutherford is Allen Thomson, the famous anatomist. Rutherford's time having been largely devoted to teaching, it may be truly said that Edinburgh, from a physiological point of view, has still its spurs to win. Had other counsels prevailed in 1855, Edinburgh might have secured the services of Sharpey, and long ere this been as famous for its physiological as for its anatomical school.

The mistakes of 1855 (when the services of Agassiz, as well as those of the founder of English physiology, were declined) are not likely to be repeated, for it is now sufficiently evident to all concerned that if the Scottish capital is to maintain and extend her medical school, she must fill her Science chairs with men who, in addition to great teaching powers, have gained by their researches a world-wide reputation. As it happens, the Court of Curators, in whose hands the appointment lies, will have the opportunity of largely atoning for the past by placing at the head of the physiological department a pupil of Sharpey's who, by his success as a teacher and worker, has placed himself in the very foremost rank of British physiologists.

In the interests of science and of the great imperial seat of learning, we, with Lord Lister, "venture to express the earnest hope that Prof. Schäfer's paramount claims may receive their due recognition."

NOTES.

THE second (or ladies') conversazione of the Royal Society will take place on June 21.

AT the next meeting (June 8) of the London Mathematical Society, the President, Lord Kelvin, G.C.V.O., proposes to read a paper "On solitary waves, equivoluminal and irrotational, in an elastic solid." At the previous Council meeting, the election of the sixth De Morgan medallist of the Society will take place, and the announcement of the result will be made to the members present at the general meeting. The presentation of the medal will be made at the annual meeting in November next.

THE International Exhibition of Electricity, organised in celebration of the Volta centenary, was opened at Como on Saturday by King Humbert. His Majesty also opened a national silk industry exhibition, connected with the electrical exhibition. Switzerland was officially represented at the ceremony, and there were also present the Bishop of Como, the Senators and Deputies representing the province in the Italian Parliament, some members of the family of Volta, who was born at Como, a number of scientific celebrities, and a large attendance of the general public. Speeches were delivered by the Mayor, the presidents of the two exhibitions, and Signor Salandra, the Minister of Agriculture, who dwelt on the progress made by Italy in the silk-growing industry.

AN international congress dealing with the prevention and cure of tuberculosis was opened in Berlin yesterday. The Emperor and Empress of Germany are taking the greatest interest in the congress, and her Majesty attended in person at the formal opening of the proceedings in the great hall of the Reichstag by the Duke of Ratibor. Some of the foreign delegates will be presented to the Emperor on Sunday after the termination of the congress. Owing to the Whitsuntide recess, the congress will have the use of the whole of the Reichstag buildings. The *Times* correspondent at Berlin reports that on Tuesday night there was an informal reception of the members and delegates by Princess Elizabeth of Hohenlohe in the main gallery of the Reichstag. The congress will be attended by nearly 2000 persons, including 112 foreign delegates and a great number of unofficial foreign members.

IT is announced in *Science* that Mr. Edward H. Harriman, of New York, has invited a number of scientific men to accompany him as his guests on an expedition to Alaska. The party will leave Seattle about the end of May, on a large steamer chartered and fitted up specially for the expedition. They expect to take the "inside passage" route to Lynn Canal, and then, after visiting Sitka, proceed westward along the coast to Yakutat Bay, Prince William Sound, Cook's Inlet and Kadiak Island. Numerous places will be visited which are out of reach of ordinary travellers, and stops will be made to admit of scientific work. Steam launches, tents, camp outfit, packers, &c., have been bountifully provided, so that the largest amount of work may be done in the shortest time.

PROF. S. P. THOMPSON, F.R.S., will be the president of the Institution of Electrical Engineers for the ensuing session.

PROF. J. A. FLEMING, F.R.S., will deliver one of the evening lectures during the meeting of the British Association at Dover in September. He has selected as his subject, "The Centenary of the Electric Current."

THE steamship *Antarctic*, with the members of Prof. Nathorst's Expedition on board, left Stockholm on Saturday for the east coast of Greenland in search of Herr Andrée and his two companions.

THE Russian members of the Russo-Swedish Expedition for taking meridian measurements at Spitsbergen, left St. Petersburg on Sunday. The leader of the expedition is Captain Sergieffsky.

MR. R. W. FORSYTH, Royal College of Science, South Kensington, has been appointed official reporter to the Physical Society.

AT the last ordinary meeting of the Midland Malacological Society, held in Mason University College, Birmingham, on May 12, the president, Mr. Walter E. Collinge, in the chair, Dr. Henry Fischer, of Paris, and Prof. H. A. Pilsbry, of Philadelphia, Pa., U.S.A., were both elected honorary members of the Society.

THE announcement of the death of Mr. G. F. Lyster at the age of seventy-six will be received with regret in engineering circles. Mr. Lyster was for a long period engineer-in-chief to the Mersey Docks and Harbour Board. He was a dock engineer of great skill and resource, and not the least of his achievements was the designing of a system of sluicing by which the docks on the Liverpool side of the river were provided with deep sills and approaches—an advantage which up to his time it was not considered practicable to secure. Mr. Lyster, who on retiring a few years ago was succeeded by his son, became a member of the Institution of Civil Engineers in 1858, and of the Royal Society of Edinburgh in 1886.

IN the House of Lords on Thursday last, Lord Harris moved the second reading of the Oysters Bill, which provides that it shall be the duty of every county and borough council to ascer-

tain the sanitary condition of oyster layings within the county or borough, and for that purpose enables the inspector to prohibit the removal of oysters from insanitary layings. Power is given to the Local Government Board to act in the event of default by the local authority, and another clause provides that Her Majesty in Council may in certain circumstances prohibit the importation of oysters from foreign countries and British possessions. The Bill was read a second time.

THE Technical Education Board of the London County Council is co-operating with the Asylums Committee in offering a valuable scholarship of 150*l.* a year, tenable for two years, for students of either sex (preferably qualified practitioners) to enable them to carry on investigations into the preventable causes of insanity. The lady or gentleman appointed to the scholarship will carry on investigations in the Pathological Laboratory attached to Claybury Asylum. A similar scholarship has been held during the past two years by Dr. J. O. W. Barratt, who has carried on valuable original investigations into the causes of insanity, many of which have been recently published. Dr. Barratt has recently been appointed pathologist at the Wakefield Asylum, and the scholarship which he has held is therefore vacant. Candidates must be resident in London. Application should be made to the Secretary of the Technical Education Board, 116 St. Martin's Lane, W.C., not later than Wednesday, June 7.

THE second engineering conference of the Institution of Civil Engineers will be held on June 7–9. The proceedings will be opened with an address by the president, Mr. W. H. Preece, C.B., F.R.S., in the theatre of the Institution, and the programme includes meetings of sections for the discussion of important engineering subjects, and visits to various works. There will be seven sections, dealing respectively with railways, harbours, docks, and canals; machinery; mining and metallurgy; shipbuilding; waterworks, sewerage and gasworks; and applications of electricity. Among the subjects to be discussed are the following:—Systems of fog-signalling; causes of earth-slips in the slopes of cuttings and embankments of railways, and how to prevent or remedy them; machine tools, with special reference to American and German practice as compared with English; recent advances in locomotive practice; the relative advantages of different kinds of power for tramways, light railways and motor-car traffic; bye-product coke ovens; the influence of casting temperature on steel; the purification of gas and the conversion of chemical residuals therefrom, including the preparation of cyanogen; effect of waves on breakwaters in different depths of water; the design of breakwaters; modern improvements in coal mining: winding from deep mines; modern practice in gold mining; comparative advantages of electricity, compressed air and steam for mining and manufacturing purposes generally; the use of filtered flood-water; sewage-sludge disposal by natural agencies, including the purification of sewage by means of artificial filters; mechanical traction by electricity; economical transmission and distribution of electricity from a distance; methods of electrical transformation; some non-integrating electric meters.

IN reference to the scientific commission which was appointed a short time ago by the Colonial Office and the Royal Society to investigate the mode of dissemination of malaria, with a view to devising means of preventing the terrible mortality which now takes place among Europeans resident in tropical and subtropical climates, Dr. Patrick Manson, chief medical adviser to the Colonial Office, has made a statement to a representative of the Exchange Telegraph Company. Dr. Manson states that Dr. C. W. Daniels, of the Colonial Medical Service, British Guiana (who first proceeded to Calcutta to familiarise himself with the work which had been carried on by Surgeon-Major Ross for determining the relation of mosquitoes to the dissemination of malaria), has now arrived at Blantyre in the Central African Protectorate, where he has been joined by Dr. J. W. W. Stephens and Dr. R. S. Christophers. At Blantyre, all the resources of the Protectorate will be placed at the disposal of the commissioners, who, before their return to London, will probably pay a visit to the West Coast of Africa.

THE Meteorological Council have notified by a special circular that they have determined that the issue of forecasts for the hay and corn harvests, which have been distributed during the last twenty years, can no longer be made gratuitously, but they will be supplied in the usual form to persons desirous of receiving them, on payment of the cost of the daily telegrams (including porterage) during the period over which the forecasts are issued. These special forecasts are issued in the afternoon, and refer to the following day; the results in previous years have been very satisfactory, the success reaching in some cases over 90 per cent.

OWING to the public improvements in the neighbourhood of Parliament Street, the Royal Meteorological Society has been obliged to vacate its offices in Great George Street and find accommodation elsewhere. The Council have taken rooms at Princes Mansions, 10 Victoria Street, which have been fitted up to meet the requirements of the Society. On Tuesday evening, May 16, the president, Mr. F. C. Bayard, held an "at home" in these new rooms, which was largely attended by the Fellows. An interesting exhibition of instruments, photographs, &c., was arranged in the various rooms, and there were also several demonstrations by the optical lantern. At the monthly meeting of the Society, held on Wednesday, May 17, Mr. H. N. Dickson read a paper entitled "The mean temperature of the surface waters of the sea round the British Isles, and its relation to that of the air." A paper by Major-General Schaw, C.B., on some phenomena connected with the vertical circulation of the atmosphere, was also read.

FOUR pieces of a meteorite which exploded and fell on the eastern slopes of Mount Zomba, British Central Africa, on January 25, have recently been added to the British Museum collection. The stones weigh respectively 14, 17, 19 and 29 ounces. The *Times* states that when the meteorite fell, an explosion was heard at Zomba, the reverberations lasting for a few minutes afterwards. The detonation was also heard at Chiromo, situated about ninety miles south of Zomba, and at Fort Johnston and beyond, a distance of about seventy miles in the opposite direction. Zomba was thus roughly the centre of the district over which the actual explosion of the meteorite took place. Ten fragments in all were found, the largest weighing 5 lbs. 12½ ozs. As far as at present known, the area over which the Zomba stones fell represents about nine miles long by about three wide, but, inasmuch as the fragments collected are only those which were seen to fall close to people or houses, it appears probable that a large number of stones may have reached the earth.

AN ingenious arrangement, invented by Mr. Walter Jamieson and Mr. John Trotter, for controlling the direction of torpedoes by means of ether waves is described in the current number of the *Electrician*. The apparatus takes several forms, although the method of utilising Hertz waves is more or less the same in various models, the difference being in the method of applying opposing currents to the rudder or steering mechanism. A satisfactory arrangement appears to be obtained by means of two solenoids, into which are sucked iron cores, attached to

the rudder head, the core which is sucked in depending, of course, upon the direction of the current received. Two rods, projecting above the surface of the water, receive the waves, and are in circuit with a coherer of special type, which affects a relay in the usual way. The actual processes involved in steering and controlling a torpedo are somewhat as follows. Let a torpedo, containing a suitable combination of the apparatus mentioned, be launched, say, from a vessel containing the necessary sending apparatus as described. Suppose the torpedo goes off its course. Then, by means of a switch an induction coil is supplied with electric current, and waves or oscillations are generated. These, on reaching the torpedo, pass into the projecting wire, and thence reach the coherer. This operates the relay, closing its secondary circuit. An electric current now flows through a "selector" to one of the solenoids, the iron core is sucked into right or left, and the helm is thus turned. When the torpedo has attained a proper course, the switch is opened and the waves cease. The vibration in the neighbourhood of the coherer restores it to the original resistance, the current passing through it becomes weaker and ceases to affect the relay coil, which therefore opens the secondary circuit and allows the helm to fly back to the midship position. A large model of the apparatus has been constructed, and it is said to work with entire success under all kinds of conditions.

THE Corporation of Bath have appropriated the necessary funds for the cost of tablets to be affixed to houses entitled to be considered as historic in their city. About forty tablets are to be put on houses which have been the homes of distinguished men, or are otherwise of historic interest, and the first of these, affixed to a house which was once the residence of Sir William Herschel, was officially unveiled on April 22 by Sir Robert Ball. The tablet is shown in the accompanying illustration, for which we are indebted to Sir Robert Ball. The inscription reads: "Here lived William Herschel A.D. 1780." In a little workshop at the end of the back garden of this house, Herschel made his Newtonian reflector, and it was from this spot that he discovered Uranus on March 31, 1781. The Bath Corporation is acting wisely in taking steps to remind the citizens of the distinguished men who have lived within their boundary, and thus incidentally added to the reputation of the city.

THE *Physical Review* (vol. viii. No. 3) contains an article, by Mr. J. G. McGregor, on the applicability of the dissociation theory to the electrolysis of aqueous solutions containing two electrolytes with a common ion. The author calculates the theoretical relative amounts of the distinctive ions transferred by the current, and compares them with observed values, for certain complex solutions. Another article, by Mr. J. O. Thompson, describes some experiments relating to the fatigue of metals. It was found by Lord Kelvin, in 1864, that a wire which had been kept vibrating for several hours or days, through a given range, and then left to itself, came to rest much quicker than when set into vibration after it had been for several days at rest. The present experiments are designed to prove that when temperature and initial amplitude of vibration are constant, and when the wire is not unduly loaded, the period and logarithmic decrement are also constant.

AN investigation of Röntgen phenomena by Mr. John Zeleny is also described at length in the *Physical Review*. The results show that during conduction through a gas under the influence of Röntgen rays, convection currents are produced in the gas, which in general move towards the electrodes. These currents are caused by the motion of the free charges existing in the gas. During the conduction, there is a rapid fall of potential within 0·1 mm. from the surface of the electrodes. By exposing the gas to Röntgen rays, the electric force acting upon the electrodes is increased.

MR. W. L. SCLATER, the director of the South African Museum, Capetown, is making arrangements for the preparation of a series of handbooks on the zoology of the southern part of

the African Continent, to be entitled "The Fauna of South Africa," which will be published by Mr. R. H. Porter. The first volume, by Mr. Arthur C. Stark, containing Part i. of the birds, will shortly appear; and the second volume on the mammals, by Mr. W. L. Sclater, is in a forward state. The volumes will be of octavo size, and will be illustrated by numerous woodcuts in the text.

FROM the *Gazette of British Central Africa* we are pleased to learn that the Administrator of Northern Rhodesia has proclaimed the large district known as the "Mweru Marsh," lying on the east side of the lake of that name, as a "game preserve," in which no game-animals are allowed to be shot without special licence. This excellent step will, we trust, tend largely to the preservation of the existence of the elephants and other large mammals frequenting that district, which has lately received rather too frequent visits from British sportsmen. The Mweru swamps will be found fully described by Mr. Croad in the *Geographical Journal* for June 1898. He says the elephant-hunting there is as good as any south of the equator.

WE have received from Herr B. Walter a reprint of his paper on the nature of electric sparks, published in *Wiedemann's Annalen*, 66. The method of investigation adopted consisted in photographing the sparks produced by an induction-apparatus on a moving plate. The diagrams thus obtained under various conditions bear some resemblance to photographs of so-called "ribbon lightning," and show that the electric spark does not consist of a single discharge alone, but of a succession of brush discharges each following in the path of the previous one. In one case, the interval between successive discharges was found to be roughly the ten-thousandth of a second.

PROFS. ELSTER AND GEITEL have sent us two papers dealing with their investigations on the nature of Becquerel rays. The experiments appear to negative the view that the source of energy of these rays is to be attributed to other radiations falling on the uranium salts which emit them, and Sir William Crookes' hypothesis that the energy is perhaps derived from the air, seems rendered doubtful by experiments made with uranium salts *in vacuo*. The authors confirm the discovery by M. and Mme. Curie of certain substances derivable from the uranium pitch of Joachimsthal, in Bohemia, possessing the property of emitting these rays in a high degree.

A SIMPLE verification of the principle of Archimedes for gases is described by M. P. Métral in the *Journal de Physique* for April. Two flasks, each of 1 litre capacity, are suspended from the scale pan of a balance. On placing the lower one in a vessel filled with carbon dioxide, the equilibrium is destroyed, but is restored again on filling the upper one with the same gas. To verify the principle for gases lighter than air, the two equal vessels are attached neck downwards by clamps to a horizontal beam suspended from the scale pan of a balance. On lowering an inverted jar of hydrogen over one vessel, equilibrium is broken, but is restored by filling the second vessel with hydrogen.

THE energy of Röntgen rays has been investigated by the Rev. Alexander Moffat by measuring the luminous energy given out by a fluorescent screen when exposed to the rays. This energy is of course very small, but it must be remembered that it only represents 4 per cent. of the energy impinging upon the screen, and also that the interval between two successive X-ray discharges is about 1000 times the period of time covered by the discharge itself. Allowing for these facts, it appears that if the Röntgen rays were continuous instead of intermittent, they would exert an effect 500 times greater than sunlight when falling perpendicularly upon a surface.

COHERERS made of platinum or gold filings do not "decohere" on shaking them up after the electric waves have ceased. The more oxidisable metals do. But as M. A. Blondel pointed out at a recent meeting of the Société Française de Physique, the greatest sensitiveness is attained when the metal is only moderately oxidisable, and good results are obtained with alloys of silver and copper artificially oxidised to a degree which can be easily recognised by the change of tint.

AN interesting and timely paper on milk as a food article appears in *Isis*. It is written by Dr. Schlossmann, and deals with the composition and properties of human and animal milk, and with the means for ensuring a proper supply of what is, with bread, the cheapest and most indispensable of food-stuffs. The adulteration of milk by water may be detected by the presence of nitric acid, which is never contained in undiluted milk. The number of dairies containing only healthy milch cows is very small indeed, but most of the danger may be averted by heating the milk to near boiling point, or by freezing it. One firm near Dresden adds quantities of milk ice to every consignment to keep it cool.

A NEW family of Palæozoic corals is introduced under the name *Moniloporidae*, by Mr. Amadeus W. Grabau (*Proc. Boston Soc. Nat. Hist.*, April 1899). In this new family it is proposed to include the genera *Monilipora* and *Ceratopora*, forms found in Devonian and Lower Carboniferous strata. The genus *Monilipora* was established twenty years ago by the late Prof. Nicholson and Mr. R. Etheridge, jun. *Ceratopora* is now described by Mr. Grabau; it appears earlier in time than the other genus, and is less specialised in structure.

MR. LAWRENCE M. LAMBE publishes a series of notes on Canadian Palæozoic corals (*Ottawa Naturalist*, February and March 1899). He calls attention to certain structural details which had previously been overlooked or misinterpreted, and he describes one new species of *Lithostrotion*.

WE have just received vol. iv., No. 3, of "Indian Museum Notes," containing, *inter alia*, an article by Mr. F. Finn, the Deputy-Superintendent of the Museum, calling attention to the abundance of small green *Homoptera* (locally known as "green bugs") in India, and suggesting that they might be imported into England as food for cage-birds. There seems, however, to be some difference of opinion among the bird-fanciers who have experimented with them as to their value; but this may be due to their being more relished by some kind of birds than by others.

Bulletin No. 19 (new series), U.S. Department of Entomology, "Some insects injurious to garden and orchard crops, prepared under the direction of the Entomologist, by F. H. Chittenden, Assistant Entomologist," relates chiefly to *Coleoptera* (flea-beetles, chafers, bark-beetles, ladybirds, &c.), *Homoptera*, and *Lepidoptera*. Special attention is called to the squash ladybird (*Epilachna borealis*, Fab.) and the squash bugs (*Anasa tristis*, De Geer, and *A. armigera*, Say), and to the recently introduced moth (*Hellula undalis*, Fab.), a South European species, which has lately been committing serious ravages on cabbage, turnip, and other cruciferous plants in the neighbourhood of Augusta, Georgia.

A DESCRIPTIVE list of recent large scale maps, including both surveys and compilations, together with a list of some large atlases, has been prepared in the Intelligence Division of the War Office by Mr. Alexander Knox, Map Curator, and can be obtained from Messrs. Eyre and Spottiswoode. The volume forms a supplement to "Notes on the Government Surveys of the Principal Countries of the World."

A GLANCE through the new edition of the catalogue of physiological instruments manufactured by the Cambridge Scientific Instrument Company shows the importance of a knowledge of physics to physiologists and biologists, for without an acquaintance with physical principles it would be impossible to design or use many of the instruments described. Special attention may be called to the completeness of the list as regards recording drums and motors, apparatus for blood analysis, and anthropometric apparatus.

SEVERAL important papers appear in volume x. of the *Bulletin* of the American Museum of Natural History, just received from New York. Among the subjects dealt with are: Mexican birds; native tribes of Mexico; new mammals from Western Mexico and Lower California; complete skeletons of *Teleoceras fossiger* and *Coryphodon radians*, with notes upon the locomotion of these animals; extinct Camelidæ of North America and some associated forms; evolution of the amblypoda, revision of the species of Euchloë inhabiting America; the Chickarees, or North American red squirrels; vertebrate fauna of the Hudson Highlands; and the Bombycine Moths, found within fifty miles of New York City.

A THIRD edition, revised and enlarged, of Prof. J. Arthur Thomson's "Outlines of Zoology" has been published by Mr. Young J. Pentland, Edinburgh. The volume, which contains more than eight hundred pages and 332 illustrations, is an inspiring text-book which students of zoology may use in the lecture-room, museum, and laboratory.—The seventh edition of "A Treatise on Practical Chemistry and Qualitative Analysis," by Prof. Frank Clowes, has been published by Messrs. J. and A. Churchill. The new edition of this successful volume has undergone a thorough revision, and some additions have been made. The organic portion of the book will now meet the needs of many medical students.—Messrs. A. and C. Black have published a second edition of Mr. C. M. Aikman's instructive little book on "Milk: its Nature and Composition." The volume provides students of agricultural science with a capital manual on the chemistry and bacteriology of milk, butter, and cheese.

MESSRS. WILLIAMS AND NORGATE'S latest *Book Circular* (Scientific Series, No. 71, May) contains a number of useful descriptive notes on recent and forthcoming scientific books, as well as the usual particulars. Among the announcements, we notice the following:—A new monthly periodical devoted to biological sciences is announced from Italy. The title will be "Revista di Scienze Biologiche," and it will be edited by Enrico Morselli.—The third edition of Beilstein's "Handbuch der organischen Chemie" is now fast approaching its completion, and the final part of the fourth volume will probably be published in the course of the coming summer. The first volume, consisting of 1586 pages, was published in 1893; the second volume, of 2211 pages, in 1896; and the third, of 1020 pages, in 1897.—The new edition of Richter's "Lexikon der Kohlenstoffverbrudungen," which is at present in the press, will contain over 60,000 formulæ. The whole of the 56,000 formulæ which appear in Beilstein's Handbook will be indexed in the work, so that reference from it to Beilstein will be easy.—"Chimie végétale et agricole" is the title of a work by M. Berthelot which is in the press, and will be issued very shortly. It will be in four volumes.—The first volume of a fourth revised and enlarged edition of Dr. G. Lunge's "Chemisch-Technische Untersuchungsmethoden" is in the press, and will be published very shortly. The work will be complete in three volumes.—"Die Einrichtungen zur Erzeugung von Röntgenstrahlen und ihr Gebrauch" is the title of a work by Dr. B. Donatti which is in the press, and will be issued very shortly.—Towards the end of this month, the fourth and final volume of Prof. P. Duhem's "Traité élémentaire de mécanique chimique fondée sur la Thermodynamique" will be issued. The following is a list of its contents: "Les melanges doubles. Statique chimique générale des systèmes hetérogènes." The volume will also contain a complete index.

THE additions to the Zoological Society's Gardens during the past week include two Green Monkeys (*Cercopithecus callitrichus*, ♂ ♀) from West Africa, presented respectively by Mr. J. B. Robinson and Mr. H. Gifford; a Yellow-whiskered Lemur (*Lemur xanthomystax*, ♂) from Madagascar, presented by Mr. C. B. Ayerst and Miss Mary F. Ayerst; a Common Ducker (*Cephalophus grimmi*, ♂), a Banded Ichneumon (*Crossarchus fasciatus*) from South Africa, presented by Mr. W. Champion; a Cinereous Vulture (*Vultur monachus*), South European, presented by H.G. the Duchess of Marlborough; a Black Kite (*Milvus migrans*), European, presented by Mr. G. H. Walker; a Chilian Sea Eagle (*Geranoaetus melanoleucus*), captured off Cape Horn, presented by Captain Bate; six Derbian Zonures (*Zonurus giganteus*) from South Africa, presented by Mr. W. L. Sclater; two Common Snakes (*Tropidonotus natrix*) British, presented by Mr. E. Haig; a Chimpanzee (*Anthropopithecus troglodytes*, ♀) from West Africa, deposited.

OUR ASTRONOMICAL COLUMN.

NEW STAR IN SAGITTARIUS.—The *Astrophysical Journal* for April 1899 (vol. ix.) contains a reproduction of a photograph of the spectrum of this star taken at Harvard College Observatory, together with a picture of a chart plate showing the position of the star on April 29, 1898, when its magnitude was 8·4.

The photograph of the spectrum shows the changes in the spectrum by a comparison of its appearance on April 19 and April 21, 1898. The first shows Hβ, Hγ, Hδ, Hε, Hζ, Hη, and possibly Hθ, as bright lines. A broad band at λ 4643 is also bright, with several other *narrow* bright bands. These are probably coincident with corresponding lines in spectrum of Nova Aurigæ. The plate taken on the later date shows several important changes, chiefly the appearance of a *narrow bright* line at λ 5005, possibly coinciding with the chief nebular line at λ 5007.

COMET 1899 *a* (SWIFT).—

Ephemeris for 12*h. Berlin Mean Time.*

1899	R.A. h. m. s.	Decl. ° ′	Br.
May 25	20 48 31	+54 41·8	1·77
26	20 26 33	55 47·5	
27	20 3 7	56 38·4	1·71
28	19 38 21	57 11·4	
29	19 12 56	57 26·1	1·61
30	18 47 26	57 20·2	
31	18 22 26	56 55·6	1·49
June 1	17 58 35	+56 13·1	

The comet is now moving very rapidly in R.A., and becoming more favourably situated for observation. During the week it passes in a north-westerly direction through Cygnus into Draco. On the 25th it will be about 10° due north of α Cygni, and on June 1 4° north of γ Draconis. It reaches its maximum northern declination on the 29th. Although its brightness has been steadily declining, it is still easily visible to the unaided eye when its position has been ascertained.

THE REGISTRATION OF OPTICIANS.

OBSERVERS of the undercurrents of scientific progress in this country cannot have failed to note during the past twelve months a very remarkable movement at work amongst the opticians, especially amongst the younger men in the optical trades. An intelligent scientific study of the principles of optics has hitherto never been required of the optician, who from the first day of his apprenticeship might grow up in the business entirely untrained in everything save the mere buying and sell-

ing of optical goods. All this is rapidly changing, as indeed was to be desired. Half a century ago, the qualification for practising as a surgeon was practically a mere serving of indentures, while the trade of druggist might be practised by one who had never had any instruction in even the elements of chemistry. There was no organisation to examine the candidates, or to certify them if qualified; there was little stimulus to study. Hence, in the absence of any controlling body, the young men growing up in the optical trades have had little inducement to acquaint themselves with even the elements of the science on which their industry is based. Even those who might be studiously inclined found little to encourage them; for, strange to say, the existing text-books of optics are of little or no use to such. They are written mostly from a different standpoint, to enable University candidates to pass academical examinations, and fail to deal with many of the problems that present themselves to the practical optician. Further, great examining bodies, such as the Science and Art Department and the City and Guilds of London Institute, have never formulated any examinations in optics or optical instrument making.

The present salutary movement has originated quite outside academic circles, having arisen in the ancient London guild called the Spectacle-makers' Company, which, like so many of the old London guilds—the Clothworkers', the Leathersellers', the Carpenters', and the Plumbers' Company—has most laudably devoted of its funds to the promotion of the industry from which it takes its name. The Spectacle-makers' Company is not one of the twelve great Companies holding landed property nor possessed of great wealth. Relatively to the great City Companies, such as the Mercers, Goldsmiths, Fishmongers, Drapers, it is poor. But it has shown much energy and enterprise in organising the certification of opticians. Briefly, what the Spectacle-makers' Company has done is this: it holds at least twice a year examinations in optics, open only to those who have entered the optical trades; and on those who have thus shown a real acquaintance both with the theory and the practice of their trade, it confers a diploma or certificate, and registers them as qualified in optics. It further admits them to the freedom of the guild. The stimulus thus afforded to those in the optical industry in this country has been undeniably very great. Optical classes have been eagerly sought in London, and have also been held in many provincial towns, and a widespread demand for optical literature has sprung up.

The scope of this movement may best be understood by a reference to the official syllabus put forward by the Spectacle-makers' Company. It states that when the Company was granted a Royal Charter in 1629, spectacles were practically the only optical instruments dealt in; but with the progress of science as other instruments were invented, the spectacle-maker became a general optician. With the division of labour which arose, the trade became divided. It is the object of the Spectacle-makers' Company to re-associate with the guild all who possess the necessary technical ability. A theoretical and practical examination must be passed by those candidates who are recommended as eligible by two established members of the craft. The full examination comprises arithmetic, algebra, trigonometry, elementary heat and light, as well as general optics, optical instruments, and spectacles, practical tests in optical work, in visual optics so far as instruments are concerned, and in matters connected with one of the following instruments: the camera, the microscope, and the sextant, at the choice of the candidate. The part of the examination relating to visual optics deals with the general anatomy of the human eye; the course of light passing through the eye and modified by lenses, cylinders, and prisms. It deals also with the simple "errors of refraction," otherwise called hypermetropia, myopia, presbyopia, and astigmatism. It requires a knowledge of trial lenses, test types, astigmatic charts, and the optometer, &c. In the practical tests, candidates are required to execute measurements of focal length, and to verify cylindrical and prismatic lenses; to use the spherometer; to determine the axis of a cylinder and the deviation of a prism; to neutralise simple and combined lenses; to transpose lens combinations; and to centre and adjust lenses and frames, &c. It has been the practice, at the inauguration of similar schemes, to make some exceptions by admitting without examination those men who had long been in practice. But the Committee of the Spectacle-makers' Company decided that even such should be examined; it conceded, however, that down to July 1, 1899, all who had spent seven years in the optical business might be accepted, provided they succeeded in passing that part of the examination which relates specially to spectacles.

The Optical Committee has itself organised classes for optical instruction, and has carefully limited the training so as not to trench on the province of the ophthalmic surgeon. As examples of this case, it may be stated that students are specially instructed that they are not to treat disease, or any case of myopia above seven *dioptres*, but refer such to an ophthalmic surgeon; and so also the cases of children whose punctum proximum is beyond 10 centimetres, or any persons who cannot, when corrected for a simple error of refraction, see 20/20 print.

The first examinations under this scheme were held in November 1898, and they were followed by a second series in March 1899. The examiners selected by the Optical Committee of the Company were Prof. Silvanus Thompson, F.R.S., Dr. Lindsay Johnson, and Mr. G. Paxton of the well-known firm of Curry and Paxton, the latter being assisted in the practical examination by Messrs. A. A. Wood and W. A. Dixey. At each of these examinations over a hundred candidates presented themselves. The examinations were strictly on the lines indicated, no questions being set as to the diseases of the eye, or in retinoscopy, or on matters outside the province of optics proper.

At the outset, it was necessary to guard against any misapprehension as to the scope and nature of the examination scheme, which might have led to difficulties between opticians and ophthalmic surgeons, such as those which in time past have arisen between pharmacists and qualified medical practitioners. Very wisely, it was decided that the examination should be confined to optical matters, and should not treat of disease, nor even of the eye at all save as an optical instrument. The examination is to test candidates solely in matters of optics, so as in no way to interfere in things that lie within the exclusive province of the ophthalmic surgeon. In pursuance of this policy, the application of the ophthalmoscope to the eye, which is a matter for the ophthalmic surgeon, is excluded from the subjects of the examination. On the other hand, the principle of construction of the ophthalmoscope, which is a matter within the province of the optical instrument maker, is included. Recognising that the use of drugs, such as cocaine and homatropine in retinoscopy, is purely a matter for the ophthalmic surgeon, the Spectacle-makers' Company not only excludes from its syllabus of examinations all optical tests implying or requiring their use, but it sternly discourages the idea that an optician should go out of his sphere to meddle with such matters. Nay, further, it requires, amongst the conditions upon which its diploma is held, that the holder shall sign a declaration that he will not use any drugs for the purpose of dilating the pupil.

It is believed that the firm stand thus made officially by the Spectacle-makers' Company will have a beneficial effect in stamping out a practice which—particularly in certain provincial centres—had been growing up of opticians, devoid of any medical qualification, administering drugs such as homatropine, and pretending to make retinoscopic tests that ought to be left to the ophthalmic surgeon. In yet one other direction the certification and registration of opticians will, as it becomes general, promote the interests of the public. There are, unfortunately, in many towns advertising opticians absolutely unqualified scientifically who deceive the public by pretending to impossibilities such as the curing of cataract without operation, and the like. The Medical Acts are unfortunately powerless to reach these; and hitherto the public has had no means of distinguishing between them and the really qualified opticians, since until now there has been no organisation to register the properly-qualified optician. But as the certification of really qualified opticians becomes general, it will be possible to detect and eliminate the quack, whilst the qualified optician will be deterred, at the risk of being disbarred, from issuing advertisements that would mislead the public. Already, even at this early stage, the advantages of organisation have become apparent, the Committee of the Company having already several times been called upon to intervene to insist on the withdrawal of advertisements which might be thought misleading to the public or unfair to other opticians.

The impulse to optical studies has been undeniable, and is certain to spread. The demand of the younger men in the optical industry for optical teaching that will be of service to them will certainly modify the abstract and jejeune courses of scholastic optics offered to them in some of the provincial University colleges, where the optics of the workshop, and even

the methods of optical testing in use in the industry, are practically unknown, and science as well as the public will be gainers by the movement. A debt of gratitude is owing to the Court of the Spectacle-makers' Company, and to its Master (Mr. W. E. Thornthwaite) for their efforts. The Company has lately received notable accessions of strength in having admitted to its freedom several of the highest names in science, including the Astronomer Royal, Captain W. de W. Abney, Sir William Crookes, and, last but not least, Lord Kelvin.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The seventh "Robert Boyle" lecture of the Junior Scientific Club will be delivered by Prof. J. G. McKendrick, F.R.S., in the large lecture theatre at the University Museum, on Tuesday, June 6, at 8.30. The subject will be "The physiological perception of musical tone."

The 201st meeting of the Junior Scientific Club was held on Wednesday, May 17. After private business, Prof. E. B. Tylor, F.R.S., read a paper on the survival of the palæolithic condition of man in the South Pacific region. Mr. R. D. MacGregor (Exeter) also read a paper on Indian butterflies.

CAMBRIDGE.—The subject of the Rede Lecture, to be delivered by Prof. Cornu on June 1, is "The Wave Theory of Light: its Influence on Modern Physics."

Admission to the ceremonies in the Senate House, in connection with the jubilee of Sir G. G. Stokes on June 2, will be by ticket. Applications must be made through members of the Senate not later than May 26.

The General Board have proposed the detailed regulations for the Board of Agricultural Studies in connection with the new Department of Agriculture. County and Borough Councils who contribute annual grants to the funds of the Department are to nominate members of the Board.

Honorary degrees are on June 2 to be conferred on Profs. Cornu and Darboux of Paris, Kohlrausch of Berlin, Michelson of Chicago, Mittag-Leffler of Stockholm, Quincke of Heidelberg, and Voigt of Göttingen.

Prof. Newton, who has recently been somewhat out of health, is to depute his lectures in zoology during the ensuing academical year to Mr. W. Bateson, F.R.S., of St. John's College.

Mr. Neville, F.R.S., of Sidney, has been appointed an elector to the chair of Chemistry; and Mr. Larmor, F.R.S., of St. John's, an elector to the Jacksonian professorship, in place or the late Mr. P. T. Main.

THE endowment of a quarter of a million for the University of Birmingham has been secured. At a meeting of the canvassing committee on Thursday last, it was announced that since the previous meeting 24,000*l.* had been promised, and that this, added to the sum previously promised, including the 50,000*l.* from Mr Carnegie and the 37,500*l.* from the anonymous donor, brought the total up to 254,580*l.*, or 4580*l.* in excess of the amount originally fixed upon. The anonymous donor, recognising that the endowment of 250,000*l.*, although sufficient for a starting point, must soon be largely augmented, has offered, if the fund is raised to 300,000*l.* by the end of June, to contribute the last 12,500*l.* The committee have now to find 33,000*l.* to secure the additional 12,500*l.* from the anonymous donor. If this is obtained, it will make 50,000*l.* altogether subscribed by Mr. Chamberlain's friend.

THE following additional endowments and gifts to educational institutions in the United States are recorded in *Science*:—An Appropriation Bill recently passed by the Illinois Legislature gives to the University of Illinois about 600,000 dollars. The Wisconsin Legislature has appropriated for the University of Wisconsin 151,000 dollars, of which 100,000 dollars is for an engineering building. The Colorado Legislature, besides passing a Bill giving its State University an income of one-fifth of a mill on each dollar of assessed valuation, has made grants amounting to about 110,000 dollars. In Nebraska, the State University has been given a one-mill tax, which will, it is estimated, yield about 168,000 dollars yearly.—Columbia University has recently received a gift of 10,000 dollars, to be known as the Dyckman Fund for the encouragement of biological research, the interest of which will be granted to post-graduate students.

THE subjoined table, showing the ratio of the teaching staff to the number of students in ten of the largest universities of the United States, is printed in *Science*. The first column gives the number of persons composing the faculty, including instructors of all grades; the second gives the total number of students enrolled in the institution; the third, the proportion students to teachers.

	Faculty.	Students.	Ratio
Johns Hopkins	123	641	5·2
Cornell	328	2038	6·2
Columbia	303	2185	7·2
California	286	2391	8·3
North-western	222	2019	9·1
Harvard	411	3901	9·4
Yale	255	2500	9·7
Chicago	212	2307	10·9
Pennsylvania	258	2834	10 9
Michigan	222	3192	14·4
Total	2620	24,008	9·1

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xxi. No. 2, April.—On systems of multiform functions belonging to a group of linear substitutions with uniform coefficients, by E. J. Wilczynski. In this memoir, the author attempts to prove the existence of certain general functions, studied herein, he believes, for the first time. The existence of a large and important class of these functions is demonstrated by an indirect method, which consists essentially in generalising the hypergeometric functions in a proper manner. The work is connected in a way with the researches of Fuchs, Schwarz and Neumann (on Riemann's theory of Abelian functions, and of Klein (*Math. Ann.*, Bd. 41). Oskar Bolza states that his principal object, in his paper on the partial differential equations for the hyperelliptic θ and σ functions, is to replace part of Wiltheiss's work (*Crelle*, Bd. 99, and *Math. Ann.*, Bd., 29, 31 and 33) by simpler and more direct proofs.—E. B. Van Vleck contributes an article on certain differential equations of the second order allied to Hermite's equation. The treatment is thorough, and the work is accompanied with numerous diagrams.—Note on differential invariants of a system of m points by projective transformation, by E. O. Lovett, shows that to generalise a theorem of Henry Smith's relative to tangent curves (*cf.* on the focal properties of homographic figures (*Proc. London Math. Soc.*, vol. ii.) and the theorem relative to parallel curves, it is only necessary to substitute "surface" for "curve" and "measure of curvature" for "radius of curvature." A second (short) paper by Bolza is entitled "Proof of Brioschi's recursion formula for the expansion of the even σ functions of two variables." The author believes that no proof of these theorems has hitherto been published. Brioschi merely stated them in a note (*Goettingen Nachrichten*, 1890, p. 237).—E. Jahnke supplies a two-page note to Prof. Craig's memoir, "Displacements depending on one, two and three parameters in a space of four dimensions."—There is an interesting prefatory notice, from which we learn that Prof. Craig, after seventeen years' connection with the editorial work of the Journal, is succeeded by Prof. Simon Newcomb, who writes this exceedingly modest notice.

Symons's Monthly Meteorological Magazine, May.—Ozone, by D. A. van Bastelaer. Since 1886, the author has persistently registered the amount of ozone and submitted reports to the Royal Society of Public Health of Belgium, and has also published five-day means throughout the year, with the idea of their being used in connection with the death-rate. Although at individual stations the amount of discoloration varies greatly from day to day, the means remain very steady both for months and for years. Some places, especially Flanders and the neighbourhood of the Ardennes, have constantly much higher means than others. Mr. Symons remarks that it has sometimes been objected that the discoloration of ozone papers is not solely due to the presence of ozone, so that the subject is generally neglected, but there is probably no equally simple and trustworthy indication of the freshness of the atmosphere, and he therefore urges that such records should be kept.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 20.—Some further Remarks on Red-water or Texas Fever. By Alexander Edington, M.B., F.R.S.E., Director of the Bacteriological Institute, Cape Colony. Communicated by Dr. Gill, F.R.S.

Since my communication[1] to the Royal Society of London, by Prof. Thomas R. Frazer, I have been able to obtain valuable additional evidence as to the communicability of the disease by the use of blood derived from animals which have been either recovered from the sickness for a very considerable time, or which have been inoculated many months previously to the date on which their blood has been used.

On December 8, 1898, I withdrew some blood from animal No. 18, which has been continuously under observation since it was inoculated on December 22, 1897. After defibrinating the blood, 20 c.c. was used to inoculate a young ox (No. 54) by intravenous injection. On the following day, a sharp rise of temperature occurred, which reached to 106°·6 F. On the following morning it was observed to have fallen to 99°·8 F. Three days later the temperature was again over 104° F., but fell previous to the next morning. From this time onward an erratic course of temperature was observed, and on the twenty-fifth day, subsequent to inoculation, it was seen to be ill; refused food, but had no definite symptoms of "red-water." Three days later it died. The blood on examination was seen to contain the spherical forms of the parasite.

On post-mortem examination, the bladder and urine were quite normal. The liver was not enlarged, but was somewhat discoloured in patches, and the biliary ducts were distended with bile. The bile was much altered, being stringy and of a greenish-yellow colour. The spleen was normal in size and consistence. The kidneys were enlarged, and the pelves were filled up by a yellowish gelatinous exudation. The cortex was somewhat congested, but there was no evidence of any true inflammatory change. The general muscles were pale in colour, and there was slight evidence of jaundice. This experiment serves to show that an animal which has been inoculated with infected blood, while it may not develop much illness as a result of it, is really infected and, moreover, its blood, if drawn as late as a year subsequently, is yet so infective that an intravenous injection of it, into susceptible animals, will certainly infect, and may even kill, although after a somewhat extended period of time.

Very important corroboration of this is furnished by the experience of inoculation for red-water, which has lately been adopted in the Cape Colony. Four animals which were immune to red-water (three by reason of having had the disease and recovered, and one by being born and reared on permanently infected veld) were sent from Fort Beaufort to Queenstown to be used by the veterinary surgeon there for inoculation purposes. The animals to be used for inoculation had been "fortified," *i.e.* re-inoculated with virulent blood, seven weeks previously.

Twenty animals were inoculated with defibrinated blood from one animal, the doses used being 10 to 20 c.c., according to age. All had a febrile reaction and some slight symptoms of the sickness, but easily recovered. From one of the other of the four animals blood was taken and used to inoculate seven head, giving doses of 10 to 15 c.c. These also all had a reaction, but made good recovery.

On November 1, the four animals were re-inoculated with virulent red-water blood, and in each case 5 c.c. was injected intravenously and 10 c.c. subcutaneously. Twenty-nine days later they were bled. With this blood two lots of cattle were inoculated.

One lot consisted of 107 animals which had not ever been exposed to red-water infection. The doses used were increased beyond those which I had recommended, namely, 10 to 25 c.c. were used, according to age. Of these animals no less than seventeen died of characteristic red-water. The remainder made a good recovery.

The second lot consisted of fifty-three head of cattle, all of which with one exception (an imported animal) had been born and reared on red-water veld. The imported animal was the only one which showed any signs of reaction, but it made a good recovery.

This experience has sufficed to show that it is not always safe to exceed the doses which I have recommended, unless the animals which have been used for withdrawing blood have been untouched for at least a considerable number of months.

I have been able, with the co-operation of several farmers, to carry out experiments by which inoculated cattle have been fully exposed to infection at later dates. In May 1898, I inoculated ten head of old cattle with blood from an animal which had been inoculated, six months previously, with virulent blood. These cattle were immediately removed from the Institute, and later sent to an infected area in company with ten head of young animals which were uninoculated, but, as is commonly known in this Colony, are not so liable to death from this disease as are older animals. Of the young stock all have been infected by exposure in the veld, and three have died. Of the older, more susceptible, animals not one has shown the slightest signs of illness, and the cows have given birth to healthy calves.

Mr. J. H. Webber had twenty-eight head of Fish River cattle inoculated on November 7, 1898, and subsequently had them removed to his farm, which is well known to be one of the worst infested areas in the eastern province. Previous experience has shown that if clean cattle are placed there they become very quickly affected with the disease. On December 5, one died from gall-sickness, but, with this exception, all have done very well, and are at this date in perfect health.

This method of inoculation has proved so satisfactory to the farmers themselves that it is being very generally adopted, and the farmers have petitioned the Government to arrange for an inoculating station being placed at Graham's Town, so that clean cattle coming from clean Karroo areas for transmission to the coast may be inoculated previous to entering the infested belt.

April 27.—"Data for the Problem of Evolution in Man. I. A First Study of the Variability and Correlation of the Hand." By Miss M. A. Whiteley, B.Sc., and Karl Pearson, F.R.S.

In a more purely theoretical discussion of the influence of natural selection on the variability and correlation of species, which one of the present writers hopes shortly to publish, a number of theorems are proved which it is desirable to illustrate numerically. But the quantitative measures of the variability and correlation hitherto published are comparatively few in number, especially when, as in the present case, we desire to have their values for a number of local races of the same species. When we have once realised that neither variability nor correlation are constant for local races but are modified in a determinate manner by natural selection and, perhaps, by use, and further that their differences are the key to the problem of how selection has differentiated local races, then the importance of putting on record all the quantitative measures we can possibly ascertain of variability and correlation becomes apparent.

This first study deals only with one character of the hand in one sex and one race. A wider range of material on the skeleton of the hand in another local race is already being dealt with. But while the correlation of the anatomically simple parts of the hand is of very great importance, it does not follow that the complex members of the living hand may not be equally, or even more, significant when we have to deal with fitness for

[1] The conclusions arrived at in that communication (received June 6 1898) were as follows:—

1. The blood of animals, themselves healthy, from a red-water area is dangerous if inoculated into an animal which suffers coincidentally from another disease.

2. That the blood of animals suffering from mild or modified red-water may be safely used to inoculate a healthy animal *subcutaneously*, but is dangerous when injected into a vein.

3. That the subcutaneous inoculation of mild or modified red-water blood conveys a mild form of the disease, and since the blood of such an animal is virulent when injected into a vein in another animal, it is safely to be inferred that the animal suffering from the mild form becomes more or less immunised or "salted."

On these grounds, I would suggest a method of protective inoculation against red-water in the following manner. Having procured a healthy animal from a red-water area or one which is known to have been "salted," inoculate it by injecting 5 c.c. of red-water blood into the jugular vein and 5 c.c. subcutaneously. In cases where the operator is unable to attempt the vein inoculation, I would recommend the subcutaneous inoculation of 5 c.c. in four different sites.

Allow at least twenty-eight days to elapse, and if any degree of illness is recognised, the blood of this animal may be used, after being defibrinated, to inoculate healthy cattle. For such inoculation only 5 c.c. should be injected into small animals, and not more than 10 c.c. into larger.

Seeing, however, that the presence of other maladies renders such a proceeding unsafe, I would recommend that it should only be practised during the autumn or winter, when the veld diseases are, as a rule, in abeyance, and in no case when any epidemic disease is in the near neighbourhood.

the struggle for existence. So far as we have been able to ascertain, although much has been written as to the fitness of the hand for its tasks, no attempt has ever been made to ascertain quantitatively the degree of correlation of its parts.[1] Hence our first object was to get some idea of the correlation of the parts of the hand from an easily measured and in practice important part. Is the hand as highly correlated as the long bones, or as loosely correlated as the parts of the skull, or does it occupy some intermediate position like that of strength to stature? We accordingly selected as an easily measured but still important character the first joint of the fingers. The measurement therefore covers, besides the fleshy parts, the head of the metacarpal bone together with the proximal phalange. It is thus not anatomically simple, but it probably has much importance for the fitness of the hand, and is a measurement which with a little care can be made with considerable accuracy. Our measurements were taken with a small boxwood spanner graduated to 1/10 inch, and provided with a vernier, so that the readings could be nominally made to 1/100 inch. Both the hands of 551 women were measured.

Relative Size of the Hands.—We conclude that the first finger joints in the right hand are very sensibly larger than in the left. In every case there is a difference of about 0·02, and this is many times larger than the probable error of the difference, *i.e.* $\sqrt{2} \times 0{\cdot}003$ about.

We might, therefore, assert that the right hand is larger than the left. This conclusion is directly opposed to that of W. Pfitzner; he asserts that there is no quantitative difference between right and left for the simple anatomical parts of the hand skeleton. His own measurements, however, really do show such a sensible difference for the *first* phalange. All then we can say as yet is that the first joint and the first phalange are larger in the right than in the left hand of women. We prefer to state no more sweeping view at present as to other parts of the hand, however strong our private opinion may be.

Variability of the Hand.—If we were to judge by *absolute* variations the index and middle fingers of the right hand are less, the ring and little fingers more variable, than those of the left hand. But if we use the more reasonable coefficient of variation, we find that all the first joints for the left hand are more variable than the corresponding joints for the right hand, and this is precisely what we might expect if there be greater adaptation by selection, or by use of the right hand. The greater the selection, the less the variability.

In the left hand the relative order of variability (as measured by the coefficient of variation) is that of the relative size of the fingers; in the right hand this is slightly modified. It would appear that in the right hand the index finger is less variable than the middle finger. The general order of utility of the fingers would appear to be middle finger, index finger, ring finger, little finger, and this exactly agrees with the order of increasing variability in the left hand. The only doubt about this order appears in the relative efficiency and utility of the middle and index fingers, which have a different order of variability in the right hand.

As all our subjects belonged to the educated classes, it is just possible that the great use of the right hand index finger in writing has something to do with this diversity.

Correlation of the First Finger Joints.—The conclusions reached are: (1) The hand is a very highly correlated organ, far more highly correlated than the skull, and even somewhat more so than the long bones. We are accustomed to give man precedence in life on account of his brain power, and it might, perhaps, be thought that the brain case would be highly correlated in its parts. Yet what we find is that the skull is extremely individual, its correlations are low, and a man could be readily identified by head measurements, whereas hand measurements would be immensely less safe. In other words, the hand, so far as its dimensions go (we put aside markings), is far closer to a type than the skull.

(2) The parts of the left hand are distinctly more closely correlated than those of the right. The only exception is the correlation of right hand middle and little fingers, which is greater than that of left hand middle and index fingers; but the difference here is considerably less than the probable error of the difference, and the general rule appears to be quite certain. Now this is a most remarkable result; but, again, how is it to be interpreted? Is it a result of selection or a use effect? For the same organ it is a rule that the greater the selection the less the variability and the less the correlation. Exceptions there can be, which will be discussed elsewhere, but this appears to be the general rule. Is the less variability and correlation of the right hand a result of greater selection, or is it after all a result of use? If the latter, we see how hopeless it is to associate constancy of correlation, or even of regression coefficients, with the idea of local races. Indeed the further we enter into the quantitative side of the problem of evolution the more important appears the determination of the influence of growth and use on both variability and correlation. Why is the right hand less variable and less highly correlated than the left? Is the answer the same as to the question: Why is civilised man less variable and less highly correlated than civilised woman?

(3) The order of correlation of the first finger joints is identical for both hands. This order is as follows:—

(*a*) The external fingers have the least correlation and the little finger always less than the index.

(*b*) A finger has always more correlation with a second than with any other finger from which it is separated by the second.

(4) The correlation between corresponding members on both sides is discussed. It is found that again the extreme pairs show least correlation, and the pair of middle fingers higher correlation than the pair of ring fingers.

It is noted that the correlation between corresponding long bones (with the possible exception of that of the radii which is within the probable error of the value for the middle fingers) is greater than that between corresponding parts of the two hands.

The memoir indicates how important it is that the effect of use on both variation and correlation should be determined. It suggests that use may have differentiated in this manner the right from the left hand. But if it has affected variability and correlation here, how far can we look upon these quantities in local races as characteristic of the intensity of selection? The memoir concludes with numerical tables giving the results of the measurements made.

May 4.—"*Onygena equina* (Willd.): a Horn destroying Fungus." By H. Marshall Ward, D.Sc., F.R.S., Professor of Botany in the University of Cambridge.

The genus *Onygena* comprises half a dozen species of fungi, all very imperfectly known, remarkable for their growth on feathers, hair, horn, hoofs, &c., on which their sporocarps appear as drum-stick shaped bodies 5–10 mm. high. The author has recently investigated the life-history of the above species, growing on a cow's horn, and has not only verified what little was known as to its structure, but has been able to cultivate the fungus and trace its course of life, neither of which had been done before, and to supply some details of its action on the horn.

The principal new points concern the development of the sporophores, which arise as domed or club-shaped masses of hyphæ and stand up into the air covered with a glistening white powder. Closer investigation shows this to consist of a hitherto undiscovered form of spores—chlamydospores—developed at the free ends of the up-growing hyphæ. The details of their structure and development are fully described, and their spore nature proved by culture in hanging drops. The germination, growth into mycelia, and peculiar biology of these hitherto unknown spores were followed in detail, and in some cases new crops of chlamydospores obtained direct in the cultures.

The development of the peridium, asci, and ascospores were also followed in detail, and for the first time.

No one had hitherto been able to trace the germination of these ascospores—the only spores previously known in these fungi—and De Bary expressly stated his failure to do it. The author finds that they require digesting in gastric juice. By using artificial gastric juice, and employing glue and other products of hydrolysis of horn, the details of germination and growth into mycelia, capable of infecting horn, were traced step by step under the microscope and fully described.

The author also found that gastric digestion similarly promotes the germination of the chlamydospores, and in both cases has not only traced the germination step by step, but has made measurements of the growth of the mycelium, induced the formation of chlamydospores on the mycelium again, and by

[1] Here, as in other cases, both zoologists and anatomists have since the days of Cuvier, talked a good deal about correlation, but would even to-day be unable to reconstruct, with anything like *quantitative* accuracy, a skeleton from a long bone, a hand from a finger joint, or a skull from a fragment.

transferring vigorous young mycelia to thin shavings of horn has observed the infection of the latter.

It thus becomes evident that the spores of *Onygena* pass through the body of an animal in nature, and, as might be expected from this, extract of the animal's dung also affords a suitable food medium for the fungus. Probably the cattle lick the *Onygena* spores from their own or each other's hides, hoofs, horns, &c., and this may explain why the fungus is so rarely observed on the living animal: it is recorded from such in at least one case however.

Very little is known as to the constitution of horn, and some experiments have been made to try to answer the question—what changes the fungus brings about. The research has bearings on the question of the decomposition of hair, horn, feathers, hoofs, &c., used as manure in agriculture; and may be not without significance in throwing light on the destruction of cuticle, hair, &c., by parasitic fungi.

"The Thermal Expansion of Pure Nickel and Cobalt." By A. E. Tutton, B.Sc. Communicated by Prof. Tilden, D.Sc., F.R.S.

The author has carried out a series of re-determinations of the coefficients of thermal expansion of these two metals with the aid of the interference dilatometer described in a former communication to the Society (*Phil. Trans.*, A, vol. cxci. p. 313; *Roy. Soc. Proc.*, vol. lxiii. p. 208). Since the determinations made by Fizeau in the year 1869, a large amount of additional knowledge has been accumulated with reference to nickel and cobalt, including the discovery of the liquid nickel carbonyl, which places processes of purification in the hands of the chemist of a character so superior to the older methods, as to render it highly desirable that re-determinations of the physical constants of these interesting elements should be carried out with specimens of the metals thus purified. By the kindness of Prof. Tilden, who has prepared such specimens with infinite care for the purposes of the investigation of other physical and chemical characters, the author has been enabled to carry out determinations of the thermal expansion with rectangular blocks varying in thickness from 8 to 13 mm. The blocks were furnished with parallel and truly plane surfaces by the makers of the dilatometer, Messrs. Troughton and Simms. The range of temperature of the observations was from 6° to 121°.

The results of the determinations of the coefficients of linear expansion α are as follows:—

$$\alpha = a + 2bt.$$

For nickel ... $\alpha = 0{\cdot}000\ 012\ 48 + 0{\cdot}000\ 000\ 014\ 8t.$

For cobalt ... $\alpha = 0{\cdot}000\ 012\ 08 + 0{\cdot}000\ 000\ 012\ 8t.$

The coefficients of linear expansion α of pure nickel and cobalt thus exhibit a slight but real difference, the coefficient of nickel being distinctly greater than that of cobalt. This is true with respect to both the constant a, the coefficient for 0°, and the increment per degree, $2b$, of the general expression for the coefficient at any temperature t, $\alpha = a + 2bt$. The difference is consequently one which augments with the temperature; at 0° it amounts to 3·2 per cent., while at 120°, the upper limit of the temperatures of the observations, it attains 4·5 per cent. Similar rules apply naturally to the cubical coefficients. The metal possessing the slightly lower atomic weight, nickel, is thus found to expand to a greater extent than the metal, cobalt, which is endowed with the higher atomic weight.

"Impact with a Liquid Surface, studied by the aid of Instantaneous Photography. Paper II." By A. M. Worthington, M.A., F.R.S., and R. S. Cole, M.A.

This paper is a continuation of a paper under a similar title, published in the *Philosophical Transactions*, vol. clxxxix., 1897.

It was there shown that, between the splash of a rough and of a polished sphere falling the same distance into water, there is a remarkable difference from the first moment of contact. The causes of this difference are now investigated.

The configuration of the water surface below the general level, when a rough sphere enters, is first studied by instantaneous photography, and the origin is traced of the bubble that follows in the wake of the sphere and of the emergent jet which follows its disappearance. The depression or crater formed round the entering sphere is surprisingly deep. This cavity segments, the lower part following as a bubble in the wake of the sphere, while the upper part fills up by the influx of surrounding water, which gathers velocity as it converges towards the axis of the disturbance, and so produces the upward spirt of the jet.

The actual displacement of the liquid has been studied by letting the sphere descend between two vertical slowly ascending streams of minute bubbles liberated by electrolysis from two pointed electrodes.

The splash of a smooth sphere is traced by gradual transition into that of a rough one as the height of fall is increased. But the course of the disturbance is largely dependent on minute differences in the condition of the surface, and even on its temperature. It was further found that dropping a smooth sphere through a flame, under certain conditions, invariably alters entirely the course of the splash. This action of the flame is proved to be no action of electrical discharge, and reasons are given for attributing it to the burning off of fine dust which has collected on the surface during the fall.

The influence of dust was proved by dusting one side only of a polished sphere, a proceeding which always results in completely changing the character of the splash on the dusted side.

A satisfactory general explanation of all the phenomena is found in the view that with a smooth sphere, cohesion is operative in guiding the advancing edge of the liquid sheath which rises over and closely envelops the sphere. If the surface is not rigid (*e.g.* is dusty), or is rough, then the momentum of the sheath carries it, once for all, away from the surface of the sphere, and the subsequent motion is quite different. The persistence of the remarkable radial ribs or flutings observable in the film that ensheaths a smooth entering sphere is completely explained by the assumption of a viscous drag spreading from the surface of the sphere outwards, and these flutings are always absent from any part of the sheath that has left the sphere. Their presence is thus an indication that there is no finite slip at the solid surface.

Experiments *in vacuo* show that the influence of the air is quite secondary. The similarity of the splash in a liquid with that due to the impact of a steel projectile on an armour-plate is referred to as requiring further investigation.

"The External Features in the Development of *Lepidosiren paradoxa*, Fitz." By J. Graham Kerr. Communicated by A. Sedgwick, F.R.S.

The eggs, averaging between 6·5 and 7 mm. in diameter, are deposited in a burrow at the bottom of the swamp. They are of a pale salmon colour without a trace of dark pigment. Segmentation closely resembles that of *Amia*. Gastrulation begins with the appearance of a row of depressions, or a continuous groove, running round about one-third of the length of the boundary between large and small cells. As this deepens to form the archenteron it shortens up, and the ultimately formed crescentic blastopore is only about a quarter of the length of the original groove. The medullary folds are low and inconspicuous, and meet behind the blastopore, which later becomes the anus. The over-arching of the medullary folds towards one another takes place to a certain extent, but the canal so covered in soon disappears, and the central canal of the nervous system is a secondary excavation. There is no trace externally of a *proto-stomal* seam running along the floor of the medullary groove. A somewhat tadpole-like larva hatches out, which assumes a remarkably amphibian appearance. This develops on each side four large pinnate external or somatic gills, upon branchial arches I, II, III, and IV. A large cement organ is also present, which during its early stages has the crescentic or U-shape so frequent in the embryos of Anura. Both cement organ and somatic gills are purely larval structures. During the atrophy of the latter they come by differential growth to be situated just over the fore limb, giving a similar condition to that well known in *Protopterus* of a larger growth.

The paper concludes with remarks of a general character upon the phenomena described.

Linnean Society, April 20.—Dr. A. Günther, F.R.S., President, in the chair.—Mr. George Murray, F.R.S., exhibited several slides of new *Peridiniaceae*, and gave some account of the method of collection by pumping, which had been found most efficacious with these organisms.—Mr. J. B. Carruthers communicated some observations on the localised nature of the parent characters in hybrid fruits of *Theobroma cacao*, on which some criticism was offered by the Rev. G. Henslow.—Mr. H. H. W. Pearson read a paper on the botany of the Ceylon "patanas," large savannahs in the forests at the same subtropical levels, and with the same climate, though not peculiar to Ceylon. These "patanas" appear to maintain their limits for long periods; but whether they thus exist on account of the

burning of the grass in autumn, or by reason of some peculiarity in the climate, or exposure, is a question on which some difference of opinion has been expressed. A discussion followed, from which it appeared that the author of the paper had not definitely settled the problem.—The Rev. O. Pickard Cambridge, F.R.S., communicated a new list of British and Irish spiders. After reviewing the existing literature on the subject, and the materials which had come to hand since 1881 for a new and revised list of species, the author pointed out that the present paper was not intended merely for the use of authors or collectors interested in local faunas, but to give (with references to primary authorities) the spiders at present known to belong to Great Britain and Ireland, leaving the question of their distribution, abundance, or scarcity to be dealt with at some future time, when the present scanty number of spider-collectors might have increased. At present, large areas of varied natural characters, in some cases whole counties, and many maritime districts, were entirely unexplored, so far as the Arachnology is concerned.—Prof. R. J. Anderson communicated a paper entitled "Imitation as a source of anomalies." Commenting upon the statement made by Profs. Krause and Testut that muscular anomalies are rare in the lower animals, whilst in man they are very common, the author considered it remarkable that no single instance had been authenticated in recent times of a mammal fairly attempting to utter a human voice-sound, although this did not apply to birds. He suggested that in the attempt to imitate, the mental act, or volition, if sustained, might favour a change of a moderate nature, and that such a change might be either progressive or retrogressive.

Geological Society, April 26.—W. Whitaker, F.R.S., President, in the chair.—Prof. Emmanuel Kayser, of Marburg, was elected a Foreign Member; and Prof. Franz Lœwinson-Lessing, of Dorpat, and Prof. R. Zeiller, of Paris, were elected Foreign Correspondents of the Society.—On limestone-knolls in the Craven district of Yorkshire and elsewhere, by J. E. Marr, F.R.S. The author begins with a general account of the district, partly founded on the published work of Mr. R. H. Tiddeman, but substantiated by his own observations. The Lower Carboniferous rocks north of the Craven Fault-system differ in character and thickness from those on the south; they exhibit little disturbance on the north, but on the south they are thrown into a series of folds, while it is also on this side that the knobs of limestone called *knoll-reefs* by Mr. Tiddeman occur. The prominent features of the knolls are the crystalline character of the limestone, the horizontality of bedding in the interior of the knolls, the general parallelism of the bedding of the exterior to the contour of the knolls, and the obscurity of the bedding. Fossils, when present, are usually very perfectly preserved and undistorted; breccias are frequently found in the shales bordering the knolls and, much less commonly, in the limestone of a knoll itself. Evidence of movement in the knolls is seen in the lenticular character of the beds of limestone, in visible folded structures, the termination of lenticular beds in hooks against a divisional plane, and in the shales by the presence of a structure undistinguishable from cleavage. Dolomitised and silicified limestones are frequently associated with the knolls, and the perfection of the quartz-crystals in certain examples of the latter variety of rock suggests crystallisation during relief of pressure. The breccias belong to three main types: (1) Fragments of limestone in a matrix of similar material; (2) large nodules of black limestone enwrapped in shales; (3) various limestone-fragments in a fine calcareous paste. Examples of each type are described, and each is explained as resulting from some form of earth-movement. Breccias of similar types are found to be produced out of grit-fragments, and in places the grits are found to be piled together by faulting so as to produce knolls, which somewhat resemble those in the limestone. Dealing with the nature of the movements, the writer argues that the Middle Craven Fault is an overthrust from the north, and that the Limestone Series has undergone differential movements with respect to the hard Lower Palæozoic rocks beneath and the massive Millstone Grit above. The limestones have been squeezed-out from under the synclines, and they have accumulated under the anticlines where the pressure was relieved. In conclusion, a number of examples of knolls are cited from other localities which show similar features, such as the limestones of Keisley, Millom, and near Dalton-in-Furness, some of the Devonian limestones near Torquay, the *Leptaena*-limestone of Dalecarlia, and the Devonian limestone of Koñeprus in Bohemia.—The limestone-knolls below Thorpe Fell, between Skipton and Grassington in Craven, by J. R. Dakyns. A band of limestone runs from Cracoe towards the north-east, folded in an anticline and dipping under shales. In several places the top of the limestone is brecciated and the overlying (Bowland) shale contains fragments of limestone. The limestone forms five abrupt conspicuous hills. The rocks in most of these hills are not bedded, and where they are bedded the dip is confusing; both in exposures outside of these and in adits inside, the limestone in some cases is amorphous and without any sign of bedding. The author considers the absence of bedding in the limestone to be a very important feature; for in the country south of the North Craven Fault, though the rock is excessively contorted, its bedding has not been destroyed.—On three species of Lamellibranchs from the Carboniferous Rocks of Great Britain, by Dr. Wheelton Hind. The first part of this paper describes a new species of *Anthracomya* which occurs in the North Staffordshire and Manchester coalfields at horizons higher than that characterised by *A. Phillipsi*. The fossil is found at Etruria, Bradwell, Stoke-on-Trent, and Fallowfield. It appears to indicate a special zone of shales and *Spirorbis*-limestone about 300 feet below the Penkhull Sandstone, and to be the only molluscan form known from the zone. A new species of *Carbonicola* is next described, partly from specimens previously supposed to be a gasteropod, a brachiopod, or even a crustacean, and partly from better-preserved specimens obtained from calcareous bands about ten yards above the Bassey Mine Ironstone in North Staffordshire. It appears to be the latest species of this genus known, and to occur in higher beds than any other species. Lastly, a new species of *Clenodonta* from Penton Linns (Dumfriesshire) is described. It occurs in a marine shale below the highest limestone of the locality, in beds referred to the horizon of the Hurlet Limestone by the officers of the Geological Survey. The bed contains gasteropods, crinoids, cephalopods, &c., with *Productus giganteus*. The species has some resemblance to *C. Halli*, Barrois, found in Spain.

DUBLIN.

Royal Dublin Society, March 22.—Prof. D. J. Cunningham, F.R.S., in the chair.—Dr. G. Johnstone Stoney, F.R.S., read a paper entitled "Survey of that part of the range of nature's operations which man is competent to study."—April 19.—Prof. G. F. FitzGerald, F.R.S., in the chair.—Prof. Letts and Mr. R. F. Blake presented the second part of their paper on the carbonic anhydride of the atmosphere, dealing with the amount and causes of variation. The authors discuss (1) the chief natural causes of evolution, (2) those of absorption, and (3) the regulating agencies, and suggest that the chief permanent natural source of evolution—namely, volcanic and subterranean emanations of carbonic anhydride—is kept in check by the absorption of the gas during rock disintegration, and eventually by cretaceous organisms which permanently remove (though of course indirectly) carbonic anhydride from the atmosphere, thus diminishing the supply of carbon necessary for the sphere of organic action. They also suggest that this "degradation" of carbon may finally lead to the extinction of all life on the globe. In the second section of the paper, the question of the temporary fluctuations in the amount of atmospheric carbonic anhydride is considered. These at the lowest estimate at times reach 10 per cent. of the total quantity. Each of the chief natural causes inducing these variations, or supposed to induce them, is discussed and the evidence reviewed; also the *rôle* which ground air plays in the phenomenon is considered. They present with the memoir a very carefully compiled list of the chief original papers which have appeared on the subject, as well as the abstracts of them.—Prof. G. F. FitzGerald communicated a paper, by Mr. D. H. Hall, on the concentration of soap solution on the surface of the liquid. This paper records the results of experiments to determine whether there is any concentration of soap solution in the superficial film of the liquid. The results showed that the soapy matter is so concentrated.—Dr. R. F. Scharff communicated a report on the Crustacea Schizopoda of Ireland, by Messrs. Ernest W. L. Holt and W. I. Beaumont, in connection with the Royal Dublin Society's Survey of Fishing Grounds on the West Coast of Ireland. The report includes a complete list of all Schizopods recorded from Irish localities. Two species, *Parerythrops obesa*, G.O.S., and *Mysidella typica*, G.O.S., are added to the British list. A new genus, Dasymysis, is erected for the reception of *Mysis longicornis*, M.-Edw., Czerniavsky's genus

Acanthomysis having been defined in such a manner as to exclude the type. Reasons are given for doubting the specific validity of *Macromysis neglecta*, G.O.S., and the characters of *Erythrops serrata*, G.O.S., are re-defined.—Prof. J. Joly, F.R.S., communicated a paper, by Mr. Kingsley D. Doyle, on the Rio del Fuerte of Western Mexico and its tributaries. The paper is a valuable series of notes, arranged topographically, concerning the geology, physical geography, and meteorology of the district explored.

EDINBURGH.

Royal Society, May 1.—Prof. Copeland in the chair.—Lord Kelvin's paper on the application of force within a limited space required to produce spherical solitary waves, or trains of waves, of both or either species, equivoluminal and irrotational, in an elastic solid, was briefly described. It will be found in the May number of the *Philosophical Magazine*.—Dr. Alexander Galt, in a further communication on the heat of combination of pairs of solid metals, mentioned that practically there was no heat of combination in copper-silver alloys, but that heat of combination was found in most of the copper-zinc alloys. The maximum was obtained when the metals, considered as bivalent elements, were in proportions approximating to their chemical combining proportions—about 49·8 per cent. copper. With diminishing percentage of copper, the heat of combination gradually diminished, becoming zero when there was about 30 per cent. of copper. With still smaller proportion of copper, *the heat of combination became negative*.—Dr. C. Wace Carlier read a paper on changes that occur in some cells of the newt's stomach during digestion. As soon as food is swallowed, secretion commences near the œsophagus and sweeps in a slow wave along the whole organ, reaching the pyloric glands in one to two hours. Each cell is exhausted in about four hours, following which there is a period of rest and recuperation lasting other four hours. During exhaustion, the nuclei undergo changes in size, losing chromatin, which is used up in the production of prozymogen. The nucleoli are effete products, derived mainly from the chromatin, and are extruded from the nuclei. The prozymogen passes into the cytoplasm and unites with an albuminous material to form zymogen, which is readily converted into zymin by the action of weak acids. Repair of chromatin begins by the passage into it of substances from the cytoplasm. These become gradually broken up, the nuclear radicle passing to the chromatin, and the albuminous material to the nucleoli as effete matter. When (but not until) this process is complete, the cell is again ready to recommence secretion if called upon to do so. Oxyutic cells divide by mytosis, and, in process of division, secrete zymin and form prozymogen from the chromatin just as cells not in process of division do.—In a paper on the leakage of electricity from charged bodies at moderate temperatures, Prof. J. C. Beattie described in detail results of experiments with zinc and iron plates coated with various substances. Under any given condition the rate of leakage of charge from the insulated plate was determined (1) at ordinary temperatures; (2) at temperatures of 150°–300° C. With the plate by itself or covered by certain materials there was no change in the rate of leakage as the temperature was raised. With certain coatings, however, there was greatly increased leakage at the higher temperatures. This was the case, for example, when zinc was coated with potassium bichromate and iodine; and when iron was coated with potassium permanganate or with potassium acetate.—Professor Tait, in a note on the linear and vector function, showed that if ϕ represented a strain with three real roots, so also did $\psi\,\phi\,\psi^{-1}$ where ψ was any linear and vector function whatever. As formerly shown, ϕ may be written as the product, $\omega\,\pi$, of two pure strains. Hence $\psi\,\phi\,\psi^{-1}=\psi\,\omega\,\psi'.\,\psi'^{-1}\pi\psi^{-1}$, in which each triple compound is obviously self-conjugate, and hence $\psi\,\phi\,\psi^{-1}$ can also be expressed as the product of two pure strains.

PARIS.

Academy of Sciences, May 15.—M. van Tieghem in the chair.—M. Prillieux took his place as a member of the Botanical Section.—Experimental application of decimal circular divisions in practical navigation, by M. E. Guyou. An account of some experiments to be undertaken on the extension of the decimal system to the instruments and tables employed in navigation. The advantages of the system and the difficulties attending its introduction are discussed.—Effects of auto-excitation of the heart by the extra-current of the electromagnetic indicator used in recording cardiac valvular movements, by M. A. Chauveau. Further experiments are described, showing the extreme sensitiveness to induced currents of the heart of the horse.—New elements of the orbit of the planet EL, by MM. Lubrano and Maitre.—Representation of uniform branches of analytic functions, by M. G. Mittag-Leffler.—Calculation of formulæ containing arbitrary functions, by M. Jules Beudon.—Want of generality in the theory of the fictitious polarisation of dielectrics, by M. H. Pellat. The theory in question is incapable of explaining the forces produced when a dielectric, originally non-electrified, is placed in an electric field.—Influence of the source of electricity in the use of Michelson's vacuum tubes, by MM. A. Perot and Ch. Fabry. The best results, as regards the production of phenomena of interference, are obtained by the use of a continuous current with an electromotive force of at least 700 or 800 volts.—On the electrolytic luminous sheath, by M. E. Lagrange.—Substitution of magnetic for mechanical action in coherers, by M. Th. Tommasina. The chains formed by the metallic particles are broken by the action of an electromagnet.—Transmission of light through turbid media, by M. P. Compan. It is shown experimentally that the nature of the light transmitted by turbid media is dependent on the dimensions of the suspended particles.—Calculation of the compressibility of a gaseous mixture from the compressibility of its components, by M. Daniel Berthelot. The method of calculation is based on Van der Waals' formula, and the theoretical numbers show a satisfactory agreement with the experimental values.—On the preparation and properties of tungsten pentabromide, by M. Ed. Defacqz. A new method for the preparation of tungsten pentabromide is described, based on the action of dry hydrogen bromide on the hexachloride at about 300° C. The satisfactory yield obtained by this process enabled the properties of the compound to be studied more completely than has hitherto been possible.—On the mixed halogen salts of lead, by M. V. Thomas. The author describes a bromochloride of the formula $3PbCl_2$, $PbBr_2$, obtained by mixing solutions of lead chloride and potassium bromide, a bromochloride PbBrCl formed by the action of bromine on the corresponding chloriodide which has previously been described, and a bromoiodide of the formula $3PbBr_2$, PbI_2. A bromoiodide having the composition PbBrI also appears to exist.—Separation and estimation of traces of bromine in the presence of a large excess of chlorides, by M. H. Baubigny. The bromine is separated from the bulk of the chlorine by distilling the salts with potassium permanganate and a limited quantity of hydrochloric acid. Less than 0·0005 gramme of bromine may thus be detected and estimated in the presence of 10 grammes of sodium chloride.—On the activity of manganese in relation to the phosphorescence of strontium sulphide, by M. José Rodriguez Mourelo. The influence of manganese carbonate, in rendering strontium sulphide phosphorescent, is similar to that of bismuth subnitrate as described in previous communications.—On pectins, by M. Em. Bourquelot. Five varieties of pectin, obtained from different plants, have now been examined. All are dextrorotatory to a greater or less extent, and their solutions are coagulated by pectase. On hydrolysis with dilute sulphuric acid arabinose is obtained, whilst mucic acid is formed on oxidation with nitric acid.—Action of toluylene-diamine on the red corpuscles of the blood, by MM. L. Lapicque and A. Vast. Experiments tend to show that the toxic action of toluylene-diamine is due not so much to a specific destruction of the corpuscles as to an alteration of the latter which facilitates their destruction by the hæmatolytic organs, and especially by the liver.—On the galvanotropism of ciliated infusoria, by M. Henri Mouton. The phenomenon of galvanotropism appears to be due to the direct action of the current, and not to the chemiotropic action of the products of electrolysis.—On the forms of conservation and reproduction of "black rot," by M. Joseph Perraud. It follows, from the author's observations, that burying the affected parts of the plant is of no avail unless the soil is subsequently left undisturbed.—*Botrytis cinerea* and the "Toile" disease, by M. J. Beauverie. The destructive action of the parasite is favoured by a high temperature, a moderately nutritive substratum, and a confined atmosphere saturated with aqueous vapour.—On the germination of *Neottia nidus-avis*, by M. Noel Bernard.—On a *tachylite* from the bed of the North Atlantic Ocean, by M. P. Termier.

AMSTERDAM.

Royal Academy of Sciences, March 25.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Zaayer reported, both on behalf of Prof. Fockema Andreae and himself, upon a letter from the Minister of the Interior, concerning the question addressed by the Belgian Ambassador to the Dutch Government with respect to prize essays.—Prof. Pekelharing reported, both on behalf of Prof. Winkler and himself, on the paper of Dr. G. C. van Walsem, entitled "An attempt at a systematical method of the normal and pathological microscopo-anatomical and anthropological inquiry into the central nervous system." This paper will be published in the Academy's *Transactions*.—Prof. J. C. Kluyver, on reducible hyperelliptic integrals. The paper deals with the algebraic conditions to be satisfied by hyperelliptic equations, when it is possible by a theta transformation of the r-order to arrive at a period matrix of which the constituents, all but the first, are equal to zero. Particularly the cases $p = 2, 3$, $r = 2, 3$ are considered. An expression of the invariant relation between the branch places is given for the case $p = 2$, $r = 3$, also a proof for the special form of the reducible integral, mentioned by Prof. Burnside (*Proc. Lond. Math. Soc.*, vol. xxiii.).—Prof. Winkler, on inquiries, made by Mr. Wiardi Beckman and himself, into the influence that expiration undergoes through faradic irritation of certain sensible and sensory nerves.—Mr. Hamburger, on the influence of salt solutions on the volume of animal cells (second communication).—Prof. Van der Waals, on an anomaly in the course of the plait-point curve in the case of a mixture of anomalous substances. All these communications will be inserted in the *Proceedings*.—The following papers were also presented for publication in the *Proceedings*: Prof. Van der Waals, on volume and pressure contraction (iii.); and on behalf of Prof. L. Boltzmann, foreign member of the Academy, on the characteristic equation of Van der Waals.—Prof. Kamerlingh Onnes, on behalf of Dr. E. van Everdingen, jun., on the galvanomagnetic and thermomagnetic phenomena in bismuth (second communication).—Prof. Bakhuis Roozeboom, on behalf of Dr. Ernst Cohen, on electrical reaction velocity.

April 22.—Prof. Van de Sande Bakhuyzen in the chair.—Prof. Bakhuis Roozeboom communicated the first experiments, made for the confirmation of his theoretical views, concerning the melting points of optical isomers. These views were confirmed in the case of mixtures, both of racemic and dextro-dimethylethereal salts of tartaric acid and of the same derivatives of diacetyltartaric acid. In the first system, the inactive ester had a higher melting point than the active one; in the second system, it was just the opposite.—Prof. Kamerlingh Onnes presented, on behalf of Dr. E. van Everdingen, jun., a communication concerning the galvanomagnetic and thermomagnetic phenomena in bismuth (a continuation of the second communication).—Prof. Van der Waals presented a paper on the deduction of the phase equation, being a controversy with Prof. Boltzmann.

DIARY OF SOCIETIES.

THURSDAY, MAY 25.

ROYAL INSTITUTION, at 3.—Water Weeds: Prof. L. C. Miall, F.R.S.

FRIDAY, MAY 26.

ROYAL INSTITUTION, at 9.—Climbs and Explorations in the Andes: Sir W. Martin Conway.

PHYSICAL SOCIETY, at 5.—On the Thermal Properties of Normal Pentane, Part 2: Prof. S. Young and Mr. Rose-Innes.—On the Distribution of Magnetic Induction in a Long Iron Bar: C. G. Lamb.

AERONAUTICAL SOCIETY, at 8.—Exhibition of Models: Lawrence Hargrave and Dr. Barton.

MONDAY, MAY 29.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Patagonia and the Eastern Andes: Dr. Francisco Moreno.

TUESDAY, MAY 30.

ROYAL INSTITUTION, at 3.—Recent Advances in Geology: Prof. W. J. Sollas, F.R.S.

SOCIETY OF ARTS, at 8.—The Revival of Tradesmen's Signs: J. Starkie Gardner.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—On the Beginnings of Currency: Lieut.-Colonel R. C. Temple.

THURSDAY, JUNE 1.

ROYAL SOCIETY, at 4.—Election of Fellows.—At 4.30.—*Probable Papers*: The Parent-Rock of the Diamond in South Africa: Prof. T. G. Bonney, F.R.S.—Results of Experiments in Telegony: Prof. Ewart, F.R.S.

ROYAL INSTITUTION, at 3.—Water Weeds: Prof. L. C. Miall, F.R.S.

LINNEAN SOCIETY, at 8.—On the High Level Plants of the Andes as illustrated by the Collections of Sir W. Martin Conway, Mr. Edward Whymper, and others: W. Botting Hemsley, F.R.S.—On some Australasian Collembola: Sir John Lubbock, Bart., F.R.S.

SOCIETY OF ARTS, at 4.30.—The Port of Calcutta: Sir Charles Cecil Stevens, K.C.S.I.

CHEMICAL SOCIETY, at 8.—The Hydrosulphides, Sulphides, and Polysulphides of Potassium and Sodium: W. Popplewell Bloxam.—On the Relative Efficiency of various Forms of Still-head for Fractional Distillation: Dr. Sydney Young, F.R.S.—The Salts of Dimethylpyrone, and the Tetravalence of Oxygen: Dr. J. N. Collie, F.R.S., and Thomas Tickle.

SATURDAY, JUNE 3.

ROYAL INSTITUTION, at 3.—The Music of India and the East, and its Influence on the Music of Europe (with Musical Illustrations): Edgar F. Jacques.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

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